TECHNOLOGY DEPT.

PUBLIC LIBRARY
JUL 10 1941
DETROIT

AMERICAN MACHINIST

July 9, 1941

Flash!—*Chief constituent of the old-time photo flash powder, magnesium has a high rate of combustion. Nevertheless it can be welded if proper methods are used*

MASON BRITTON, Vice-Chairman
FRED H. COLVIN, Editor Emeritus
BURNHAM FINNEY, Editor
KENNETH H. CONDIT, Consulting Editor
JOHN HAYDOCK, Managing Editor

BEN C. BROSHEER — WILLIAM J. HARGEST
C. G. SMITH — RICHARD K. LA BAN
RUPERT LE GRAND, Detroit — RAYMOND R. WIESE, Chicago
PAUL WOOTON, Washington — CHAS. F. McREYNOLDS, Los Angeles

N. O. WYNKOOP, Publisher
W. E. KENNEDY, Manager

McGraw-Hill Publishing Company, Inc.

Publication office, 99-129 North Broadway, Albany, N. Y. Editorial and executive offices, 330 West 42nd Street, New York, N. Y. Branch offices: Chicago, 520 North Michigan Ave.; San Francisco, 68 Post Street; Aldwych House, Aldwych, London, W. C. 2; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta.

JAMES H. McGRAW
Founder and Honorary Chairman

JAMES H. McGRAW, Jr., President — HOWARD EHRLICH, Executive Vice-President
MASON BRITTON, Vice-Chairman — B. R. PUTNAM, Treasurer
D. C. McGRAW, Secretary — J. E. BLACKBURN, Jr., Director of Circulation

VOLUME 85 — NUMBER 14

AMERICAN MACHINIST, Copyright 1941 by McGraw-Hill Publishing Co., Inc. Published every other Wednesday, price 35c a copy. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, 330 West 42nd Street, New York, N. Y. Subscription rates — United States, Canada, Mexico and Central and South American countries $5.00 a year, $8.00 for two years, $10.00 for three years. All other countries $8.00 a year, $13.00 for two years, $16.00 for three years. Entered as second class matter, September 29, 1936, at Post Office, Albany, N. Y. under the act of March 3, 1879. Printed in U.S.A. Cable address: "McGrawhill, New York." Member of A.B.P. Member of A.B.C.

A McGRAW-HILL PUBLICATION

PRINTED IN U.S.A.

MAJOR ARTICLES

The Welding of Magnesium.....*H. O. Hoglund* 637
Subcontracts Speed Production.....*Horace Wall* 641
When You Machine Stainless.....*W. B. Brooks* 643
Oxyacetylene Flame Hardening.....*J. G. Magrath* 647
Short Cuts for the Small Shop.....*A. H. Waychoff* 666

ARMAMENT SECTION

How G. E. Makes Pack Howitzers..... 651

SHORT ARTICLES

Lamps Soften Plastic Sheet..... 644
Machine Tool Priorities.....*Fred H. Colvin* 688
More Men for British Production.....*John S. Trevor* 688
Arc Welding Aluminum..... 55
Machine Constant in Gear Design.....*Ed West* 55
Deep Hole Drilling.....*Frank C. Hudson* 55

IDEAS FROM PRACTICAL MEN

Safety Hanger for Locomotive Tires.....*Arthur Havens* 648
Retainers for Knockout Rods.....*H. R. Hageman* 648
Indexing Fixture for Connecting Rods.....*Harry Blenman* 649
Parallels Aid Grinding of Long Work.....*S. J. Putnam* 649
Tapping Perfect Pipe Threads.....*L. F. Southwick* 650

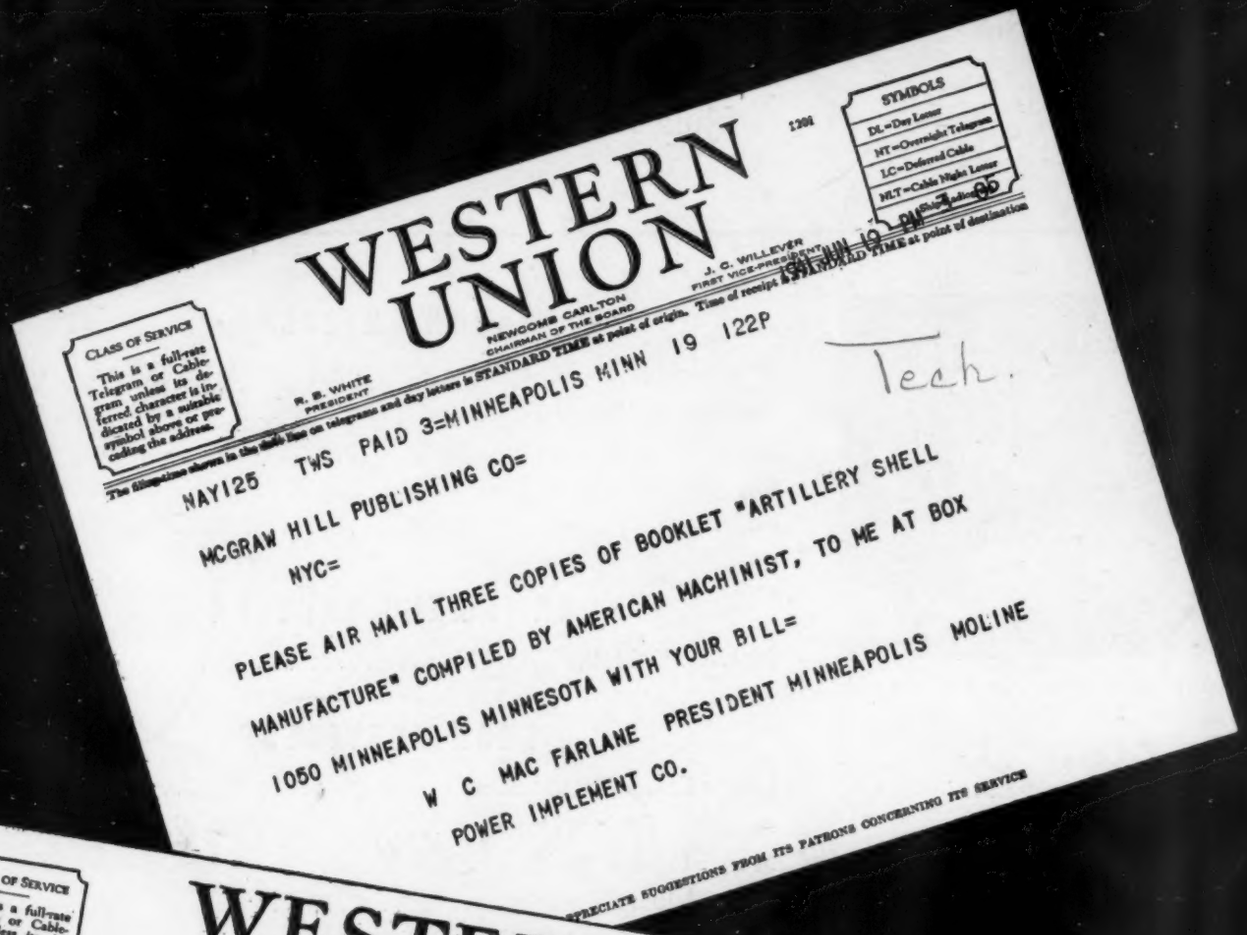
NEWS OF THE INDUSTRY

Gaging Business..... 670b
Inside Detroit..... 670g
Watching Washington. 670i
Names in the News... 670k
Plant Expansion..... 670k
Obituaries..... 670l

DEPARTMENTS

Reference Book Sheet.. 667
Editorial 670a
Shop Equipment News. 671
New Materials..... 684
Trade Publications..... 684
To the Editor..... 687

EMERGENCY!



WESTERN UNION

NEWCOMB CARLTON
CHAIRMAN OF THE BOARD

J. C. WILLEVER
FIRST VICE-PRESIDENT

R. B. WHITE
PRESIDENT

CLASS OF SERVICE
This is a full-rate Telegram or Cable-gram unless its deferred character is indicated by a suitable symbol above or preceding the address.

SYMBOLS
DL=Day Letter
NT=Overnight Telegram
LC=Deferred Cable
NLT=Cable Night Letter
Ship Radiogram

The filing time shown in the date line on telegrams and day letters is STANDARD TIME at point of origin. Time of receipt is STANDARD TIME at point of destination

1941 JUN 19 PM 1 00

Tech.

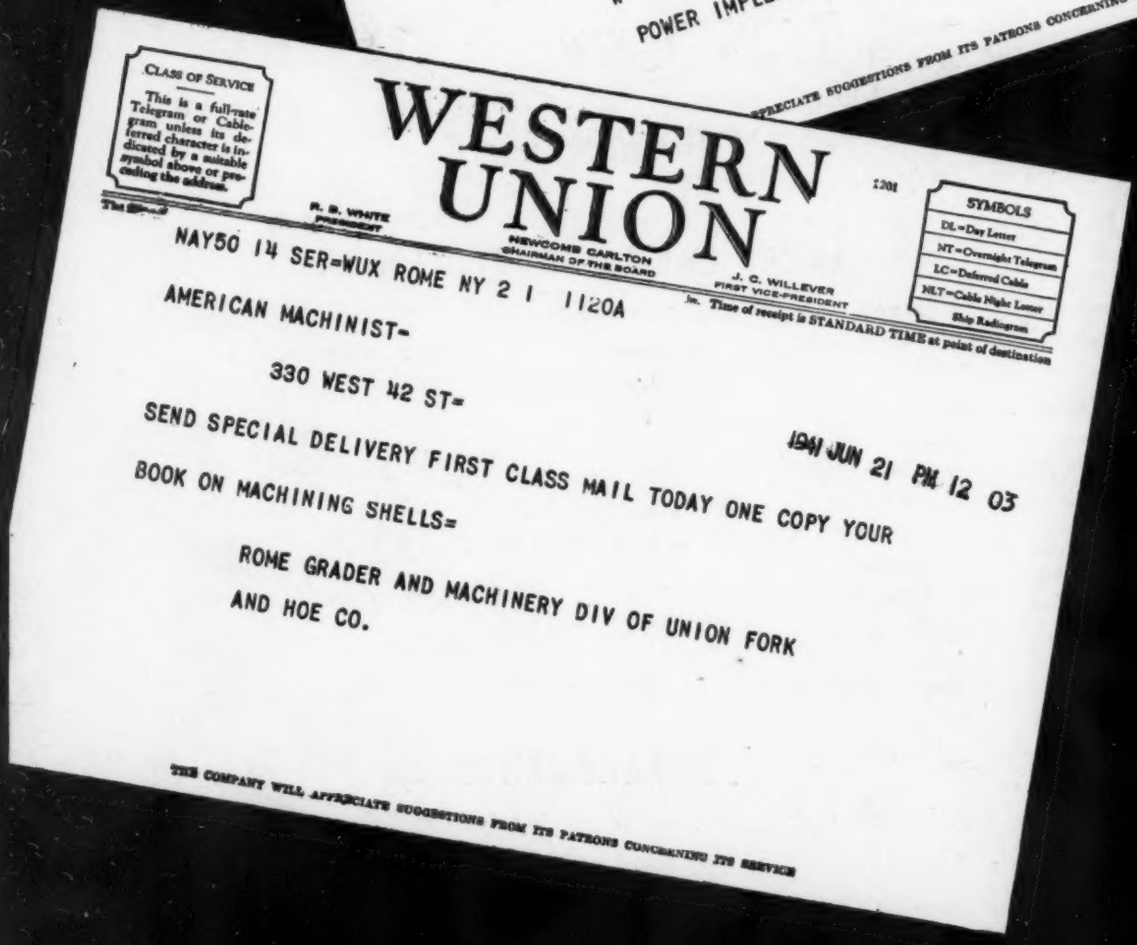
NAY125 TWS PAID 3=MINNEAPOLIS MINN 19 122P

MCGRAW HILL PUBLISHING CO=
NYC=

PLEASE AIR MAIL THREE COPIES OF BOOKLET "ARTILLERY SHELL MANUFACTURE" COMPILED BY AMERICAN MACHINIST, TO ME AT BOX 1050 MINNEAPOLIS MINNESOTA WITH YOUR BILL=

W C MAC FARLANE PRESIDENT MINNEAPOLIS MOLINE POWER IMPLEMENT CO.

THE COMPANY WILL APPRECIATE SUGGESTIONS FROM ITS PATRONS CONCERNING ITS SERVICE



WESTERN UNION

NEWCOMB CARLTON
CHAIRMAN OF THE BOARD

J. C. WILLEVER
FIRST VICE-PRESIDENT

R. B. WHITE
PRESIDENT

CLASS OF SERVICE
This is a full-rate Telegram or Cable-gram unless its deferred character is indicated by a suitable symbol above or preceding the address.

SYMBOLS
DL=Day Letter
NT=Overnight Telegram
LC=Deferred Cable
NLT=Cable Night Letter
Ship Radiogram

Time of receipt is STANDARD TIME at point of destination

1941 JUN 21 PM 12 03

NAY50 14 SER=WUX ROME NY 2 1 1120A

AMERICAN MACHINIST=

330 WEST 42 ST=

SEND SPECIAL DELIVERY FIRST CLASS MAIL TODAY ONE COPY YOUR BOOK ON MACHINING SHELLS=

ROME GRADER AND MACHINERY DIV OF UNION FORK AND HOE CO.

THE COMPANY WILL APPRECIATE SUGGESTIONS FROM ITS PATRONS CONCERNING ITS SERVICE

TWO MORE of the flood of telegrams, letters and phone calls rush-ordering copies of "Artillery Shell Manufacture," 128-page reprint of recent *American Machinist* articles. Almost a thousand copies have been sold within three months at a dollar apiece — because *American Machinist* is, as usual, first with the latest in Metal-Working.

R v.85 pt.2 July-Dec. 1941

WHAT'S IN THIS ISSUE

PACK HOWITZERS

The General Electric Company's Erie works has been manufacturing the 75-mm. pack howitzer for some time. Except for a few special machines, such as rifling machines, G.E. has been able to do this precise work and meet Army specifications by using its regular equipment. Although it became necessary to add some new machines as production increased, the manufacture of the G.E. howitzers is an outstanding example of an industry swinging into defense production with a minimum of plant alterations. The pack howitzer, rated as one of the finest produced, is being turned out at the rate of 35 a month. A lot is really being accomplished. You can't afford to miss this issue's Armament Section which, beginning on page 651, tells the story of "How G.E. Makes Pack Howitzers."

STAINLESS STEEL

Sharp tools, adequate lubrication and reduced cutting speeds are mandatory "When You Machine Stainless." In an article by that name, beginning on page 643, W. B. Brooks, formerly of the Stainless Steel Division, Carnegie-Illinois Steel Corporation, offers expert instruction on the machining of 18–8 stainless steel. In his words, "Machining operations mean more than the mere removal of metal." When you read this data, you will agree with him, too.

COST AND STRUCTURE

When the first in a series of articles on Oxyacetylene Flame Hardening began in the last issue of AMERICAN MACHINIST, the first question raised was: "Sounds okay. But tell me, how does it work and how much does it cost?" Part II of this series answers that question. "Cost and Crystalline Structure" by J. G. Magrath, applied engineering department, Air Reduction Company, begins on page 647. This installment is especially pertinent and one you won't want to miss.

SHORT CUTS

Small shops can make pipe carriers to handle any size of pipe so they won't slip out of position, pinch the hands of workmen. Scales and squares won't slip on polished surfaces, broken taps can be removed, and you can easily prevent the snapping of twist drills. You can perform these and other achievements if you follow closely the hints prescribed by A. H. Waychoff in "Short Cuts for the Small Shop." Turn to page 666.

BENT PIPES

There's more than one way to measure bent pipes. A. B. Cox returns as a contributor to AMERICAN MACHINIST with "Calculations of Bent Pipe Lengths" to tell you how to do it. The material is so useful we have included it as a Reference Book Sheet beginning on page 667.

WELDING MAGNESIUM

When welding magnesium the rising temperature may cause parts to buckle or the metal to crack. Magnesium is also susceptible to corrosive action because of the welding flux. Too, there are other mishaps which may occur anytime during the operation. H. O. Hoglund, Aluminum Company of America,

H. O. HOGLUND

provides valuable remedial data in his article, "The Welding of Magnesium," beginning on page 637. The information may save you many anxious moments in the shop.

SUBCONTRACTING FOR PROFIT

"If it's impossible, we'll do it immediately! But if the task absolutely cannot be done, it'll take us a little longer!" That's the attitude of the General Electric Company which, since the start of the U. S. preparedness program, has been up to its ears in contracts. With more work than the company itself could handle much of it has been subcontracted to hundreds of concerns. If you want to know how it's done, how G.E. helps subcontractors turn out precision work, and what the company is learning from its experience, read Horace Wall's account of how "Subcontracts Speed Production." It starts on page 641.

HORACE WALL

SOFTEN IT BY LIGHTS

Plastic sheets must be softened before cutting out switch parts in a punch press. One method found astonishingly successful is the use of infra-red installations. For a vivid description of this procedure turn to page 642.

COMING

The action of chip flow as influenced by various rake and clearance angles on single-point cutting tools such as lathes, planers, and miller cutters have been found photogenic. Anyway L. T. Weller and E. M. Watson, General Electric Company, who have used high-speed photography to study chip flow, relate some interesting findings in the next issue of AMERICAN MACHINIST. L. A. Bannister and John Lawrence will tell about "Precision in Spindles" from a Jones & Lamson Machine Company point of view. In the Armament Section in the July 23 issue you will find the complete story of how General Motors is manufacturing 0.30-cal. and 0.50-cal. Browning machine guns in mass-production quantities. Emphasis will be on tooling up, modifications of old methods, and the new tools developed for gun barrel drilling, reaming, broaching the rifling, and chambering.

Large Radius Bends . . .

of truck panels are accurately formed on Cincinnati All-Steel Press Brakes. Exclusive Cincinnati Press Brake features include eccentrics located in the housings, uniform distribution of working loads, center-line loading, deep bed and ram.

Write for Recommendations on Your Job

THE CINCINNATI SHAPER CO.

SHAPERS · SHEARS · BRAKES

CINCINNATI, OHIO.

ESTABLISHED 1877 **AMERICAN MACHINIST** BURNHAM FINNEY, Editor

The Welding of Magnesium

BY H. O. HOGLUND, ALUMINUM COMPANY OF AMERICA

Both electric resistance and gas torch welding methods now are being used commercially to join magnesium aircraft structures

When torch welding magnesium, any type of weld that may produce pockets or corners where flux might become entrapped must be avoided

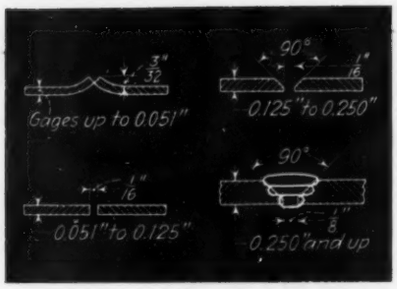
AS MAGNESIUM is heated during welding, or cools after the weld is made, it passes through a temperature just below its melting point at which its strength is extremely low. At the same time stresses are set up in the metal as it expands or contracts with the temperature change. These stresses are quite large because of the relatively high coefficient of expansion of magnesium. This coefficient increases as the temperature increases. Expansion can cause the part to buckle, or the stresses present during expansion or contraction can cause the metal in the weld, or next to the weld, to crack as it passes through the temperature at which the metal strength is low.

Cracking can be minimized by proper welding practice, and careful design of the magnesium parts will allow the expansion and contraction to take place freely. Planning the location of the weld near supporting members helps to reduce buckling.

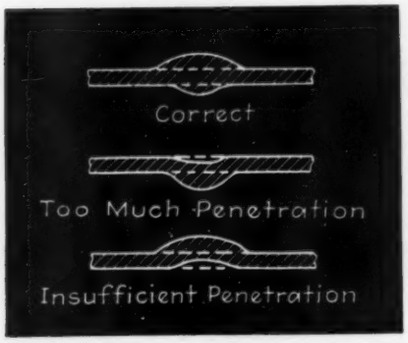
Magnesium is susceptible to corrosive action because of the welding flux used and care must be taken to remove the flux immediately after welding, and to avoid inclusion of the flux within the weld. To insure this only the butt-type weld can be recommended in the case of gas welding. Lap welds, or any type of weld that may produce pockets or corners where flux might become entrapped, must be avoided. No flux is needed in electric resistance welding such as spot, seam and flash butt welds—all of which are being used successfully with magnesium alloys.

Torch welded joints are made in magnesium alloy sheets, extruded sections, tubing and castings, but magnesium alloys cannot be welded to aluminum or to other metals. Of the wrought alloys AM3S, AM52S, and AM53S are readily welded, with AM3S being somewhat superior. (Alloy designations are those of the American Magnesium Corporation, a wholly owned subsidiary of Aluminum Company of America.) Other alloys, such as AM57S, AMC57S and AM-65S, have fair weldability. Magnesium alloy fittings may be welded into magnesium sheet structures; the fittings may be cast, forged, or machined from extruded bar stock.

The welding rod should, in general, be of the same composition as the material being welded; in fact, strips cut from sheet may be used instead of welding rod if no rod is available, but uniform welds may sometimes be a little more difficult to produce with strip than with rod. Several sizes of



Preparation of sheet magnesium for welding depends on thickness of material to be joined



This sketch shows the cross section of a correct weld, and the undesired cross section obtained with too much and too little penetration

rod are available for use with different thicknesses of metal to be welded, as shown in Table I. The rod is stocked with a dichromate coated surface which should be removed with steel wool or a wire brush before using. When fittings are welded into sheet structures, the welding rod chosen is often AM57S. The low melting temperature of this alloy reduces the chance of cracking, since the welded metal freezes while the filler metal is still molten and can accommodate the contraction at these critical temperatures. When the weld metal freezes, the surrounding parent metal is relatively strong.

When gas welding, the flame is handled in practically the same way as in welding aluminum and other metals. Oxyacetylene gas is preferred to oxyhydrogen because it makes sounder joints and the non-oxidizing properties of the burned gases afford protection to the molten metal. A neutral flame should be used. Table II gives the recommended tip orifices for use with different sheet thicknesses. The flame is held at an angle of 30 to 45 deg. to the work, with 30 deg. preferred for thin sheets to prevent the torch from burning holes in the sheet.

A coating of oxide is always present on the surface of bare magnesium and unless removed would hinder the coalescence of the filler material and the parent metal. The welding flux breaks up the oxide film and prevents the formation of a new coating during welding. The special flux used is not intended to remove the yellowish dichromate coating with which the welding rod and most magnesium materials are supplied; this coating must be removed with a wire brush or steel wool before fluxing. The flux is supplied as a powder and is mixed with water to form a paste. A fresh mixture should be prepared each day as it loses its effectiveness if kept much longer. The flux is applied to both the rod and the work; dip the rod in the flux or brush it on, and brush the flux onto the underside of the parts to be welded.

The preparation of the material to be welded depends on the sheet thickness. For sheets up to 0.051 in. thick, the metal is flanged up and when welded the flange is melted down to form a plain butt weld. For thicknesses of 0.051 to 0.125 in. no preparation is necessary other than cleaning and fitting. For heavier gages the edges are notched with a chisel to a depth of $\frac{1}{16}$ in. every $\frac{3}{16}$ in. along the joint. These notches facilitate penetration of the weld. Sheets above 0.125 in. thick may be beveled on a 45 deg. angle to about two-thirds of the sheet thickness, instead of being notched, and on thicknesses over 0.250 in. the edges must be beveled and the bead laid down in several passes. As in the welding of any metal, it is best to have the parts being welded of approximately the same thickness at the junction. If slightly different thicknesses must be welded, the heavier section should be preheated so that both edges of the seam will begin to melt at the same time.

Before starting the weld, the parts should be carefully fitted with about $\frac{1}{16}$ in. clearance—$\frac{1}{8}$ in. for plate 0.250 in. and up. Tight clamping is to be avoided, since the design of the parts, if properly done, is based on allowing full freedom of the parts to expand and contract during welding. Tight clamping is more apt to lead to cracking than to prevent it. The flux is brushed onto the clean rod and onto the underside of the parts, and tack welds are made at intervals of $\frac{1}{2}$ to $1\frac{1}{2}$ in. depending on the design and the sheet thickness. Close spacing of the tack welds and accurate line-up of the parts helps to reduce buckling. Welding toward the ends of the seam for a distance of 1 to 2 in. minimizes warping and possible cracking of the seam. If the sheet warps during tacking, it should be straightened out with a wooden hammer while it is hot. Flux is brushed onto the tacked spots and the entire seam welded. At the end of the bead an excess of metal should be deposited at as low a temperature as possible. A thick bead here will prevent shrinkage cracks.

A smooth weld can be obtained in one pass by keeping the welding wire in the molten pool of metal and not removing unless absolutely necessary. Everything should be ready for making one pass that is as long as possible. Fluxing should be complete before the start, including sufficient flux on the welding rod to avoid stopping to redip the rod in the flux. Welding progressively and concentrating the heat produces the best weld. The more the flame is passed over the metal, the greater is the chance of buckling and possible cracking. For this reason preheating the parts or going over the bead several times is to be avoided if possible.

In the case of plate 0.250 in. and over, the weld bead must be laid down in several passes, but the material is thick enough to prevent buckling. Best results will be obtained if the welding of heavy plate sections, where several passes are required, is done in an atmosphere of carbon dioxide gas in order to avoid oxidation. The whole part is placed in a vessel of carbon dioxide and the welding carried out in that gas.

If any portion of any weld in magnesium alloys should begin to burn, the work must be stopped and the oxidized portion completely scraped and filed out because this oxide may be a source of corrosion and will act as an inclusion in the joint unless re-

Table I—RECOMMENDED WELDING ROD SIZES

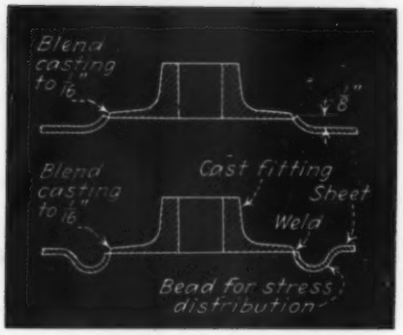
Welding Rod Size No.	*Diameter Inches*	*Wall Thickness of Section to be Welded—Inches*
1	$\frac{3}{32}$	Up to 0.040
2	$\frac{1}{8}$	0.030 to 0.060
3	$\frac{5}{32}$	0.050 to 0.110
4	$\frac{3}{16}$	0.100 to 0.220
6	$\frac{1}{4}$	0.200 to 0.400
8	$\frac{5}{16}$	0.300 and Over

Table II—RECOMMENDED TIP ORIFICES

Metal Thickness (Inches)	*Diameter of Orifice in Tip (Inches)*
Below 0.050	0.025–0.040
0.050–0.080	0.035–0.050
0.080–0.125	0.045–0.060
0.125–0.250	0.055–0.070
0.250–0.500	0.065–0.080
Over 0.500	0.075–0.090

Table III—MACHINE SETTINGS FOR SPOT WELDING AM3S-O

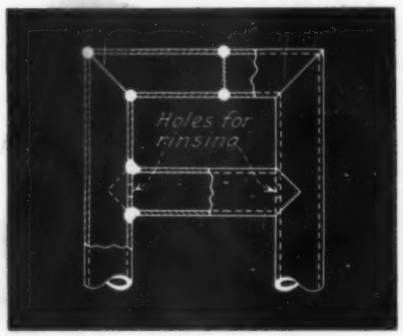
Gage B. & S.	Thickness In.	Time Cycles	Pressure Pounds	Current Amperes	Top Tip	Bottom Tip	Spots to Clean Tips	Spot Diam. In.	Lb./ Spot Shear
26	0.016	3	500	21,000	5/8"—7°	5/8"—Flat	6	.060	60
24	0.020	3	550	22,000	5/8"—7°	5/8"—Flat	8	.080	90
22	0.025	4	600	23,000	5/8"—7°	5/8"—Flat	10	.100	120
20	0.032	4	700	24,000	5/8"—7°	5/8"—Flat	12	.120	170
18	0.040	6	750	26,000	5/8"—7°	5/8"—7°	14	.160	250
16	0.051	8	850	28,000	5/8"—7°	5/8"—7°	16	.200	330
14	0.064	10	950	30,000	5/8"—7°	5/8"—7°	14	.240	480
12	0.081	12	1000	33,000	5/8"—7°	5/8"—7°	12	.280	710
10	0.102	12	1100	38,000	7/8"—7°	7/8"—7°	10	.350	1000
8	0.128	15	1200	43,000	7/8"—7°	7/8"—7°	8	.400	1350



Cracking can be avoided, when welding large cast fittings into sheet, by providing a bead in the sheet to allow for expansion and contraction

Table IV—MACHINE SETTINGS FOR SPOT WELDING AM53S-O

Gage B. & S.	Thickness In.	Time Cycles	Pressure Pounds	Current Amperes	Top Tip	Bottom Tip	Spots to Clean Tips	Spot Diam. In.	Lb./ Spot Shear
26	0.016	2	550	16,000	5/8"—7°	5/8"—Flat	8	.080	80
24	0.020	3	600	17,000	5/8"—7°	5/8"—Flat	10	.100	130
22	0.025	3	650	18,000	5/8"—7°	5/8"—Flat	12	.125	170
20	0.032	4	700	20,000	5/8"—7°	5/8"—Flat	14	.150	250
18	0.040	4	750	22,000	5/8"—7°	5/8"—7°	18	.200	330
16	0.051	5	850	25,000	5/8"—7°	5/8"—7°	20	.250	480
14	0.064	5	900	28,000	5/8"—7°	5/8"—7°	17	.270	720
12	0.081	6	1000	30,000	5/8"—7°	5/8"—7°	14	.300	980
10	0.102	7	1100	31,000	5/8"—7°	5/8"—7°	12	.340	1180
8	0.128	8	1200	33,000	5/8"—7°	5/8"—7°	10	.380	1350



Fillet welds can be used when welding magnesium tubing, but holes must be drilled as shown to allow flux removal

moved mechanically. When closed structures like tanks are repaired, and it is impossible to apply the flux to the underside of the seam, the structure can be filled with carbon dioxide gas to prevent oxidation on the penetration surafce.

When welding large cast fittings into sheet, cracking can be avoided by providing a bead in the sheet around the fitting to allow for expansion and contraction. The fitting may be welded over a heated aluminum forming die, another practice which prevents cracking. Rapid or non-uniform cooling or quenching after welding is not desirable.

The flux must be completely removed immediately after the weld is completed, using a wire brush and hot water. If all the welding areas cannot be thoroughly cleaned in this way, as is the case with closed vessels, the welded parts should be placed in boiling water containing 0.5 per cent sodium dichromate for two hours. All welded structures should be given a dichromate treatment, which gives magnesium materials their usual yellowish appearance. After the washing treatment, dry the parts thoroughly, preferably with a heated air blast.

"As welded" joints usually are specified on aircraft jobs, but if a dressed weld is wanted it may be produced by chipping or milling the bead followed by hammering, using light blows to avoid cracking. AM57S and AMC57S should not be hammered as the alloys work harden rapidly and such treatment may produce slight and scarcely visible cracks in the weld. Welds joining castings and sheet should not be hammered. If welds in AM53S alloy are to be hammered, weld rod of AM53S will give the best results. Complete cleaning and treating with dichromate must be done before dressing the bead; otherwise flux might be hammered into the metal and not removed by any subsequent cleaning operation.

When welding tubing, fillet welds can be used as shown in the accompanying sketch. Holes are drilled in the tube walls to allow flux removal and to permit complete dichromating. Welding over rivets is not recommended because it is almost impossible to avoid the inclusion of flux in the weld. The rivets used in magnesium alloy structures usually are made of an aluminum alloy and if welded over the resulting alloy would be brittle and of uncertain composition.

With the exception of cast fittings welded into sheet structures, the welding of castings is limited to the repair of minor surface defects in castings in locations not subject to high stresses in service. By heating the casting to 600 F., cracking can be avoided, and in the case of complicated castings the heating should be done slowly in an oven at a rate not over 100 F. per hour and cooled after welding at the same rate. Only simple castings should be heated with the torch. The weld area is cleaned with a chisel or file and the edges beveled or notched unless the wall is as thin as $\frac{1}{8}$ in.

In electric resistance welding the problem of flux removal is absent since no flux is used. Buckling or cracking will not be encountered. The general technique of welding magnesium alloys by this method is the same as for other metals. With equipment of adequate current capacity properly adjusted for the material being welded, joints can be made that are dependable and strong.

The welding current needed at the tips of the spot welding machine is given in Tables III and IV for machines settings for AM3S-O and AM53S-O alloys. Other alloys will

require different settings, but in all cases the requirements will be less than for AM3S-O. The tables also indicate the range of welding times and the electrode pressures required.

Best control of welding time is obtained with electronic equipment, although good mechanical or magnetic contactor timing equipment is satisfactory when the material being welded is 0.040 in. or greater. Timing range of 1 to 20 cycles with an accuracy of ± 1 cycle from 4 cycles to 20 cycles and perfect timing from 1 to 3 cycles will cover practically all the magnesium spot welding needs.

The pressure control mechanism should insure duplication of electrode pressure ± 5 percent. Air operated equipment will provide this accuracy, while with cam and spring operated equipment careful attention to electrode-work spacing is necessary to insure proper control of electrode pressure.

Select Electrodes Carefully

Electrodes of ordinary copper are unsatisfactory, as the high pressure employed distorts the contacting surfaces. Special hard, high conductivity copper-base alloys are made for the purpose of avoiding this deformation. A $\frac{5}{8}$-in. diameter tip is satisfactory for currents up to 35,000 amp., while for currents up to 50,000 amp. a $\frac{7}{8}$-in. diameter tip should be used. The tips should be water cooled to within $\frac{3}{4}$ in. of the welding face. The electrode cone should have a 166-deg. included angle and the proper contour of the face of the electrode in contact with the work must be maintained. When a smooth surface is wanted on one sheet, a flat tip may be used against that surface. When one sheet is less than 0.040 in. thick the flat tip is used against the surface of the heavier sheet so that the weld slug will be produced at the sheet junction in both sheets and not mostly or even entirely in the heavier sheet. The total resistance in the heavier sheet is greater than that of the thin sheet and with the flat electrode against the thicker sheet the current densities in each sheet will be more nearly equalized and the weld zone will be made at the sheet junction. After 10 to 20 spot welds, the tips will have picked up enough magnesium to cause them to stick to the work and possibly cause burning of the surface of the welds. A medium grade of emery cloth is used to keep the tips free of magnesium pickup, care being taken to maintain the original tip contour.

Before any material is spot welded, the dichromate coating is removed from the surfaces with sand paper, emery cloth, or wire brush. The dichromate coating varies in thickness and in composition, and to insure consistent size of spots this coating should be removed. The cleaning operation should be done within 3 or 4 hours of the time the welds are made. Pencil marks or finger marks at the spot location are to be avoided because they increase local surface heating which increases the rate of magnesium pickup on the electrode tips.

The accompanying tables of machine settings for spot welding magnesium alloys are approximately correct, but because of differences in various lots of material, trial welds should be made on the same material as the job to be welded, using the same method of cleaning, spot spacing and edge distance on the sample as on the job.

To adjust the machine for a particular job, the time and pressure is set as suggested in the table, but the current is adjusted to only 75 percent of the value indicated. Trial welds are made and the current increased until the desired weld size, as shown in the table, is obtained. The weld may be examined for size by placing a number of welds in the sample piece and driving a chisel between the sheets and between the spots. A slug of metal will pull from one of the sheets at each weld location. The diameter of the slug is increased by increasing the current. Small changes in time have little effect on weld size. Increasing the current or decreasing electrode pressure increases pickup of magnesium on the tips, and also adversely affects the appearance of the weld. If molten metal is squeezed out between the sheets the pressure should be increased or the current decreased.

Control Weld Zone

The cast weld zone should not extend to the sheet surface. The extent of the cast zone can be determined by cutting a section through the weld, dressing the cut smooth with a file and etching with a 10 percent solution of acetic acid. The weld zone will show up as a difference in color and structure from the wrough metal structure. This method of examination is a good way to check the slug test and is standard procedure in some shops.

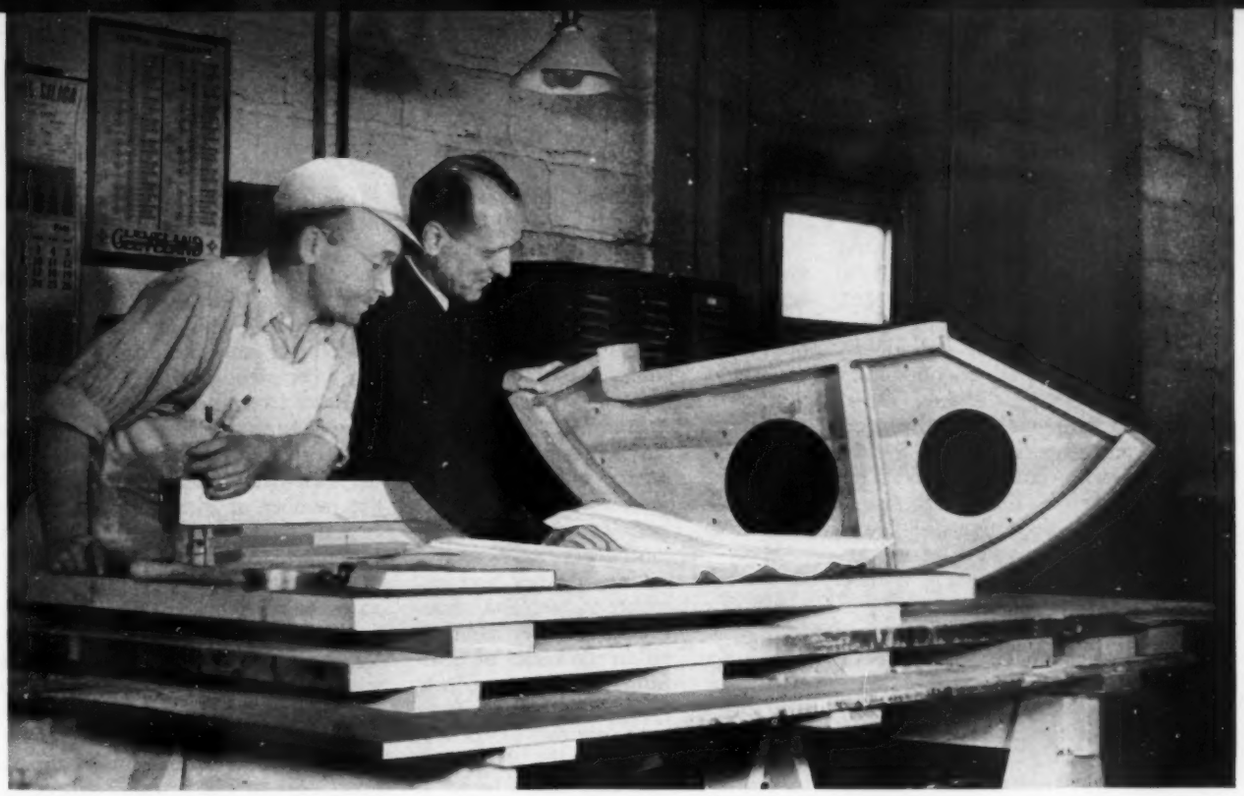
Spot welds may be made in magnesium alloy sheets, extrusions and castings provided the total thickness does not exceed the capacity of the welding equipment. As a rule the various sheet, extrusion and casting alloys may be spot welded to one another. In welding dissimilar alloys and unequal thicknesses the tip areas should be such that the fusion zone is centered in the joint. One sheet should not be placed over another twice as thick and the thinner should be placed against the conical tip if possible.

Adequate spacing between spots and sufficient edge distance helps in obtaining sound welds. With proper spot spacings any failure that might occur probably will be in the sheet rather than in the weld. Where maximum joint efficiency is required, two or three rows of spots should be used and the spot spacing should be increased until the total strength of the spot welds is approximately equal to the strength of the material welded.

Electronic Timing Desirable

In seam welding the successive spots may overlap to form a pressure tight weld or the spots may be intermittent and similar to spot welds, but in many cases produced at lower cost since the operation is faster and fuller automatic. Electronic timing equipment is necessary to control accurately the time of each current pulse and the time between successive current pulses. Machine settings are best determined by making trial welds and examining them by tearing the welds apart. Wheel speed and time between successive impulses should be adjusted to give the desired number of spots per inch of weld and then the current and pressure may be varied to obtain the desired width of weld. A continuous band of weld metal equal to two or three times the sheet thickness should be obtained. Current and pressures are somewhat higher than those required for spot welding, but the total time that current is flowing is approximately one-half of that recommended for spot welding. The length of time current is on should be about 20 to 25 percent of the time that the current is off. A liquid-tight weld requires twenty spots per inch for 0.020-in. material and eight spots per inch for $\frac{1}{8}$-in. material.

Another type of electric resistance welding is flash butt welding. Machine settings for this method vary with the shape and the area of cross section and can best be determined by trial. Special clamping dies that fit the shapes to be welded are necessary to hold the part firmly against the force needed for upsetting. Therefore the process is not economical for lots of less than 500 parts. Most magnesium sheet and extrusion alloys may be joined by the electric butt welding method. The advantages of electric resistance welding are being recognized by designers of magnesium alloy structures, and the use of this joining method is growing.



An inspector (right) and a subcontracting pattern maker look over a pattern destined for the Erie Works

Subcontracts Speed Production

BY HORACE WALL, GENERAL ELECTRIC COMPANY

The General Electric Company, employing hundreds of concerns as subcontractors, has learned much by experience. G. E. aids others in their precision work

IN APRIL, 1941, General Electric Company ran a full-page advertisement. "Wanted: Precision Manufacturing Facilities" were the headlines; the text went on to explain what facilities were required for subcontracting defense work, and how those interested in undertaking such production should proceed in establishing contact with the company at Schenectady. At the same time the advertisement was published in a great many trade papers. There was an immediate response on the part of more than 500 concerns. Subcontracts have already been undertaken by some of those responding, and without doubt it is only a matter of time before still others will be engaged in such work.

Publication of this advertisement did not mean, however, that not until then had G.E. been seeking subcontractors. The company has always been a prime contractor in supplying various defense materials to all of the country's armed services. Ordinarily all of the work on these products has been done within the company's departments, except for normal supplies of different devices furnished regularly by outside vendors according to government specifications. With the enormous increase in production demanded by the new defense plans, however, it necessarily followed that the production facilities of the company would be taxed beyond capacity should it be necessary to do all of the production work. The necessity and importance of farming-out as a means of increasing and expediting the production of defense materials was early recognized. We were aware of the fact that subcontracting of defense orders to small shops, particularly those not accustomed to doing work of the precision character, entails responsibilities and a considerable amount of educational work on the part of General Electric as a prime contractor. It should be emphasized, incidentally, that what complications have arisen have been the result of inexperience on the part of the subcontractor rather than any lack of desire to produce to specifications.

For parts normally manufactured in the Schenectady Works, General Electric in early June was employing nearly 100 outside concerns. Most of these were in New York State, but both New England and Ohio were well represented and so, to a less extent, were Pennsylvania, Michigan, and New Jersey. Throughout the company the story is similar. More than 100 plants are supplying parts to Erie; nearly 100 to the River Works at Lynn, and smaller numbers to the West Lynn, Bloomfield, Philadelphia, Bridgeport, Fort Wayne, and the other widespread General Electric factories. In each case, of course, most of the suppliers are fairly close to the particular General Electric factory requiring the work, but there are enough exceptions so it can truthfully be said that the subcontracting for General Electric's defense work is well spread throughout the manufacturing centers of the country.

Work of all kinds is required. Cur-

rently, well over 15 million dollars worth of annual business is being supplied in the farm-out program in excess of normal purchases; and our subcontracting is being further expanded. At another time the proportion might be different, but as of today the largest single classification farmed-out covers tools, dies, jigs, fixtures, and molds. Second only by a small amount comes the item of castings. Wire, cable, enamel, and synthetic wire insulation are third, and gears and shafts fourth. Other items with conspicuous totals include, in order of value: plastic compounds, patterns, forgings, steel fabricated parts, screw machine parts, machine work, cap screws, vacuum tube parts, and metal stampings.

In obtaining the names of possible subcontractors, numerous sources have been called upon. There have been many cases of direct inquiries received by our purchasing or manufacturing departments. Some have been obtained through government channels and others through state, sectional, and municipal surveys which are becoming more and more available. As still another example, there was the recent Defense Production Clinic held in mid-May in Buffalo. That meeting of prime contractors and potential subcontractors was well attended, not only by manufacturers from both groups in the Buffalo area but also by some more distantly located prime contractors.

Subcontractors May Increase

While the subcontracting field has been so well canvassed that at first glance it might seem that a recanvass would be futile, still it remains that conditions are forever changing. We know that as time goes on, more and more non-defense manufacturers are going to find it difficult, if not impossible, to obtain the raw materials upon which they depend for normal production; and that serious curtailment, if not complete shutdown, of their manufacturing facilities will result. They, therefore, naturally become candidates for defense work as subcontractors.

Many and varied are the types of shops and plants which have undertaken subcontracting work. At first glance, for instance, it would hardly seem that a manufacturer of mattress-tying machinery would be the type of shop for planing turbine valve chest covers, but such is the case.

Our experience has indicated that most of the smaller companies do not have the large assortment of diversified equipment necessary to take care of precision work, but that all are well equipped to do work on general production. The larger, well-equipped plants are seldom available for subcontracting work since to a large extent they are already loaded with their own defense problems and unable to take on additional work.

In some cases subcontractors are producing parts directly allied with defense orders. In other cases, work within the General Electric plant has been re-arranged so that subcontractors can take on non-defense products, leaving our own machines free for high-precision defense work. Such a procedure has been necessary largely because of a shortage of machine shop facilities on the outside that work to sufficiently close tolerances.

Many subcontractors have started their work believing that they have had plenty of experience in precision manufacture. However, while they had been thinking and talking in terms of thousandths or ten-thousandths of an inch, their production actually had not been held within such narrow limits. It followed, then, that at the start many subcontractors became disheartened at the apparently large proportion of rejects they were experiencing. With time, however, and with the assistance of the General Electric "flying squadron," the production records were improved rapidly.

General Electric now has an extensive farm-out organization to handle all subcontract work. The personnel includes experts in their lines, and it has been found that best results are obtained by assigning specific problems to men qualified to handle them. For instance, we would not assign screw machine problems to a man who is a qualified expert in the manufacture of metal castings. In this way we are in a position to give the subcontractor all the necessary assistance to the end that a good job can be produced by him.

We have found it necessary to send these experts, our "flying squadron," to the various subcontractors' plants particularly while they are involved in initial production. They assist in seeing that the work is properly planned, efficiently and precisely produced, and correctly inspected during and after production. Only by such a procedure can we be sure that the parts will fit into the assemblies without needless rework on our part as the prime contractor.

Government inspection and approval of subcontract facilities are necessary before defense orders can be placed, and a thorough inspection of all completed work is made by both government and General Electric inspectors in the subcontractor's plant before the material is shipped to us.

Terms of contracts between G.E. as primary contractor and the suppliers vary. In some cases, particularly tool design work when the subcontractor has had plenty of experience with this line of work, the price may be at a fixed rate. In most cases, however, competitive firm price is required from subcontractors and if found competitive it will be acceptable.

For those who are contemplating subcontract work, we have the following recommendations:

Make a complete inventory of your manufacturing facilities, indicate the tolerances to which your various pieces of equipment will operate, determine the number of man-hours and square feet of floor space available for subcontract work, and ascertain the amount of direct labor that can be absorbed without expansion of present facilities.

Bear in mind that the tolerances specified must be rigidly adhered to, and that inspection for flaws in material are necessarily severe.

Unless your normal production has been close to the type of subcontract you are undertaking, you should expect difficulties in starting and in meeting early quotas. For some time you should consider your production as educational for the best results.

Those With Work to Farm Out

As a result of our experience, for those contemplating the letting of subcontracts we have these recommendations:

Plan on as long-time schedule of subcontract production as possible so as to avoid bottlenecks which almost surely will result if a new subcontractor is presented with the task of high production immediately upon accepting an order.

Know in detail all of the facilities available in the plant of the subcontractor so that plans can be made for considering increased production if required.

Plan on providing supervisory assistance, production charts, cost figures, and inspection, particularly in the early days of the planning and production.

Watch the production, not only in goods delivered but also in work in progress so as to avoid sudden bottlenecks which would be reflected in your own future production.

Be ready to supply not only supervisory but also trained operating personnel as may be required, and to supply special machinery or raw materials which the subcontractor himself might be able to obtain only after a long delay. Supply the subcontractor with complete details and do not hold back trade secrets. After all, he is doing the job for you, and he needs all the help you can give him.

When You Machine Stainless

BY W. B. BROOKS, FORMERLY WITH CARNEGIE-ILLINOIS STEEL CORPORATION

Remember that 18-8 stainless has some peculiar properties that must be considered if a quality job is to be done

MACHINING OPERATIONS mean more than the mere removal of metal. Compromises are frequently necessary. Tools, design and operating technique must be adapted to the known characteristics of the metal to be machined. And similarly, modifications may be made in the composition and treatment of the metal to accentuate certain desirable physical properties and minimize undesirable characteristics. Considerable research and experimental work has been done along these lines.

The accompanying table presents the analysis and major physical properties of the familiar 18–8 stainless steel. Properties which affect machining this steel are its low heat conductivity, high coefficient of thermal expansion and high ductility, as well as its unusual capacity for work-hardening.

The ultimate cause of tool failure is heat. The problem, therefore, is to determine the sources of heat, reduce them as much as possible, and perfect methods whereby unavoidable heat can be removed.

Fig. 1 illustrates a simple open lathe turning operation. Heat is generated at points *A* and *C* by friction, and at *B* and *D* by the distortion of the chip. The most important point is *A*, where heat is generated by pressure of the chip on the tool. Every machinist has seen tools burned at this point instead of at the cutting edge where difficulty might normally be expected. If the area around *A* is permitted to develop a high temperature, heat cannot be conducted away from the cutting edge at *C* as rapidly as is necessary for best results, and frequently tool life and efficiency are reduced. The first problem, therefore, is to minimize heat generation at *A*.

In mild steel and bessemer screw stock, tool design is commonly such as to cause shearing and gouging, rather than *cutting*, the shearing action occurring along the line *E-F* as shown in Fig. 2. In the case of 18–8 steel, however,

RECOMMENDED PRACTICE

1. Use liberal rake and clearance angles.
2. Employ sulphur and sulphur-chlorine cutting fluids liberally to lubricate and cool the tool and work.
3. Use first quality high-speed steel tools.
4. Keep the tools sharp and smooth. Hone after grinding.
5. Use a generous feed and cut below the work-hardened surface resulting from the preceding cut. Use rigid equipment having sufficient power to assure continuous cutting.
6. Reduce cutting speeds 20 to 50 percent from those used on machine steels.
7. Support the tools rigidly.

ANALYSIS AND PROPERTIES OF 18-8 STEEL

ANALYSIS

Carbon	0.09 percent
Manganese	0.40 percent
Phosphorus	0.012 percent
Sulphur	0.009 percent
Silicon	0.35 percent
Chromium	18.25 percent
Nickel	9.20 percent

PROPERTIES

Melting range	2550–2590 F.
Structure	Austenitic (face centered cubic)
Magnetic permeability	U = 1.03 (non-magnetic)
Thermal conductivity	0.039Cal/CM²/Sec/deg.Cat100C.
Coeff. thermal expansion	9.6 x 10^{-6}/deg. F. (32–212 F.)
Tensile strength	85,000 lb. per sq. in.
Yield point	35,000 lb. per sq. in.
Elongation in 2 in	65 percent
Reduction of area	70 percent
Izod impact	100 ft. lb.
Brinell hardness	160

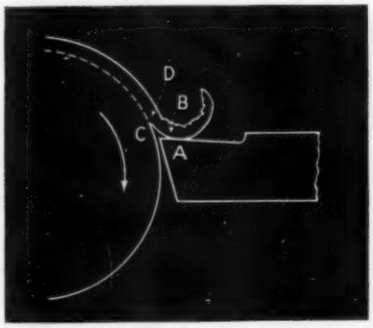


Fig. 1—Heat is generated at A *and* C *by friction, and at* B *and* D *by chip distortion*

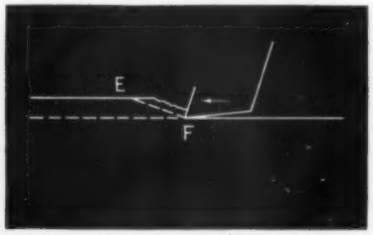


Fig. 2—Tools ground to shear or gouge, rather than cut, can be used for mild steel and bessemer screw stock, the shearing action taking place along the line E-F

we are dealing with a material possessing much higher ductility, and at the same time subject to a much higher degree of work-hardening. As a result, turning operations on 18–8 stainless steel normally produce a tough, strong, continuous chip. Furthermore, tools ground to large cutting angles will cause the ductile 18–8 to pile ahead of the tool in a highly work-hardened condition.

The factors of pronounced work-hardening, low heat conductivity, and high thermal expansion, all inherent in 18–8 steel, make it desirable to keep distortion in and ahead of the chip at a minimum. Grinding the cutting tool to an increased rake provides a degree of relief in that the chip meets the tool at a more acute angle and slides over the surface more easily rather than bearing almost perpendicularly on the tool and developing excessive heat as it curls away. Rigid support of the tool is essential to good results.

As the piece being machined heats up, the high thermal expansion of 18–8 stainless steel will act to cause a greater bearing pressure at *C* (Fig. 1) than is the case with other steels. Consequently, the relief and position of the tool must be carefully adjusted when cutting 18–8 to avoid excessive bearing pressure at the cutting point. Similarly, it may be necessary to "slack back" on the centers if the work heats up.

It has been found that good practice in machining 18–8 involves increased back and side rake and relief, together with decreased cutting angles on the lathe tools. The rake should be 15–20 deg., with a side rake of 5–10 deg., and a front and side relief of 5–10 deg., has been found satisfactory.

Limits to changes in this direction are imposed by three factors: (1) A point will be reached where chatter will develop—this must be avoided; (2) the tool should not be weakened too much; and (3) sufficient metal must be provided at or near the cutting edge to conduct the heat away effectively. Good high-speed steel tools, plus a liberal use of coolant, will give the best results in machining 18–8 stainless steel.

Lubrication and cooling should receive careful consideration when machining 18–8. Good lubrication serves to reduce heat generation to a minimum. Further, it should be noted that practically all of the satisfactory cutting fluids and coolants (lard oil, water, carbon tetrachloride, organic sulphur compounds, etc.) are good extreme pressure lubricants. The precise action of these materials is not fully understood, but it is rather generally believed that in many cases they are absorbed, or chemically combine with the bearing surfaces of the metal in such a manner as to reduce the coefficient of friction at points *C* and *A* (Fig. 1).

Careful temperature measurements and observations indicate that seizing and galling involve actual welding. Sulphur and phosphorus have a pronounced adverse effect on weldability and their beneficial effects on machinability are well known. The recognition of chlorinated hydrocarbons as good extreme pressure lubricants has led to their use as cutting fluids. There are some now on the market which contain both sulphur and chlorine.

Sharp tools are essential for machining 18–8 stainless steel. A dull tool will soon "glaze" the surface of the work so that subsequent cutting becomes difficult, if not impossible. The surface of the work as well as the chip becomes work-hardened and consequently the feed should be great enough to get below the work-hardened surface on succeeding cuts. It is good practice to employ somewhat greater feeds in turning 18–8 stainless steel than are usual with mild steel. Cutting speeds of 40–60 linear ft. per min. are permissible for ordinary heavy work, but for very heavy work it is advisable to use even slower speeds. For light work and finishing cuts, cutting speeds may be increased to 50–100 linear ft. per min. In all cases, cutting should be continuous because of the work-hardening property of 18–8 steel.

Several types of 18–8 steel are now available that possess improved machinability and these should be considered in high production operations. Phosphorus added to the metal acts as an "anti-welding" element. Sulphur likewise serves to decrease the possibility of welding during cutting operations, as well as to increase inclusions in the metal. Solenium acts in both capacities.

Inclusions in the metal promote chip breakage and therefore serve to relieve pressure and friction on the tool at *A* (Fig. 1). Unfortunately, however, chip breakage causes shock on the tool and is not conductive to securing good finish on the work. Experience has demonstrated that it is not safe to assume that continuity or discontinuity of the chip is the final answer to the problem of machinability.

Cold drawing acts to improve machinability by reducing the ductility of the metal and placing the surface of the piece in a state of strain that facilitates the cutting action of the tool.

Lamps Soften Plastic Sheets

A TEMPORARY $50 infra-red installation has worked successfully in softening plastic sheets before cutting out switch parts in a punch press in the Soreng-Manegold plant. It replaced a strip heater because so much heat was needed to soften the center of a stack of sheets in the oven that the outer ones would blister.

Eight 7½-in. reflectors with 260-watt carbon lamps were mounted on standard wiring channel which was held at the desired height by two bent $\frac{7}{16}$-in. rods sliding in $\frac{3}{8}$-in. iron pipes fastened to the wood table. Top of the 12-in. wide table was covered with polished cold-rolled steel plate so the plastic sheets would not stick. Lamps were placed about 10 in. above the table for softening $\frac{1}{8}$ in. thick sheets.

By adjusting the height of lamps, cutting banks of lights in or out, varying the length and speed of conveyors, or by making the units portable, infra-red heating can be made highly flexible. In those cases where this method of heating has been successful it has proven a space and time saver.

Cost and Crystalline Structure

COMPILED BY J. G. MAGRATH, APPLIED ENGINEERING DEPARTMENT, AIR REDUCTION COMPANY

What does it cost and how does it work are leading questions on any subject. When asked in connection with a new shop process they become especially pertinent

Factors bearing upon the total net cost of oxyacetylene flame hardening are:

1. *Depth of hardness*—The greater the depth of hardness required, the greater the volume of gases consumed. Hardening time for a definite depth is determined by the size and heating capacity of the flame hardening torch tip. A tip having a large heat volume per unit area will require less time to heat to the required depth, whereas one of insufficient volume will cause heat dissipation into the core and will require a longer time to bring the surface to the hardening temperature.[1]

2. *Size of area hardened*—When the progressive method is employed on flat or circular surfaces, the width of the torch tip will determine the width of area treated and thus determine the number of passes necessary for hardening surfaces of a dimension wider than the tip.[1]

3. *Speed of torch travel*—Determined from the depth of hardness required and the heating capacity of the torch tip.

4. *Analysis of steel to be hardened.*

5. *Heat conductivity of steel.*

6. *Cost of labor, oxygen, acetylene and quench medium.*

The unit of one square inch of surface hardened provides the easiest measurement for cost estimating. Roughly the gas consumption required per square inch of surface treated will vary from 0.2 cu.ft. of each gas, oxygen and acetylene, for an approximate depth of hardness of $\frac{1}{16}$ in. to 0.5 cu.ft. of each gas for an approximate depth of $\frac{1}{4}$ in. Table I provides more detailed data for estimating net oxyacetylene flame hardening costs. To these must be added labor costs for setting up and handling as well as shop overhead to obtain approximate gross costs.

The data in Table I is based on employing a standard 4-in. wide, integral flame hardening tip, providing heating

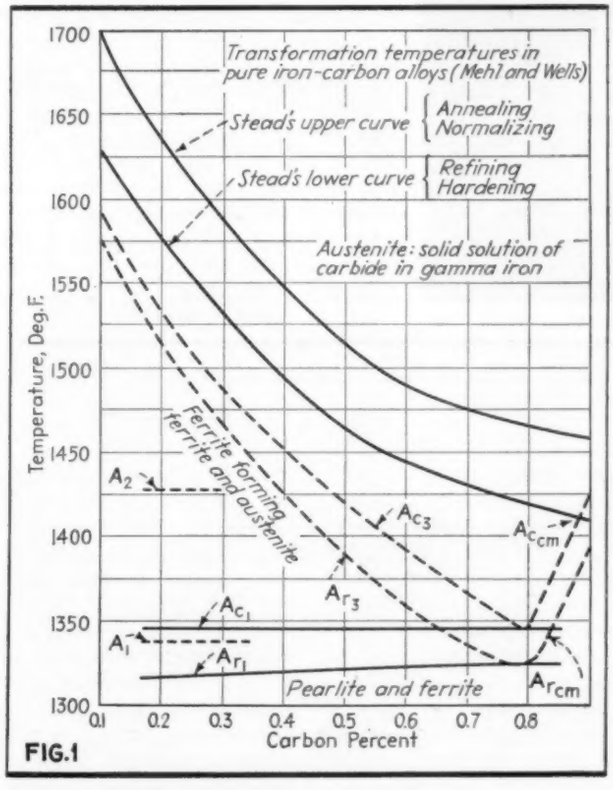


FIG.1

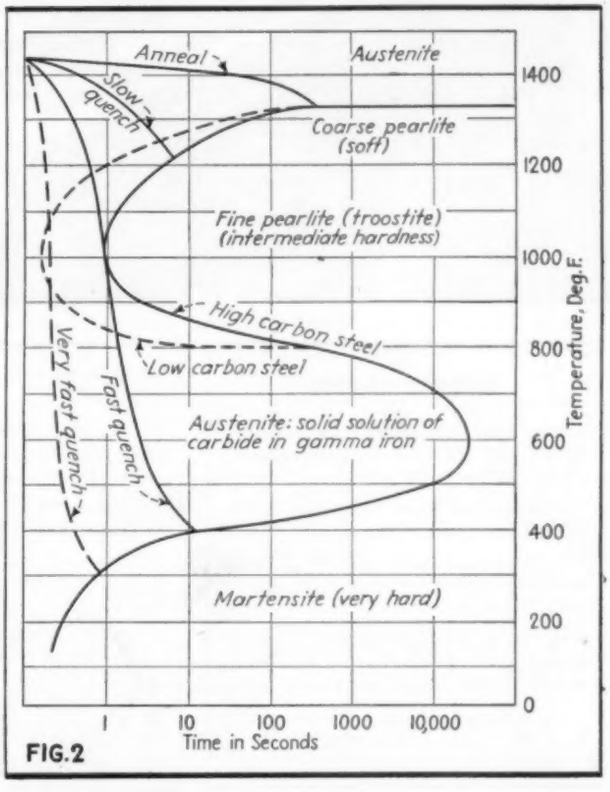
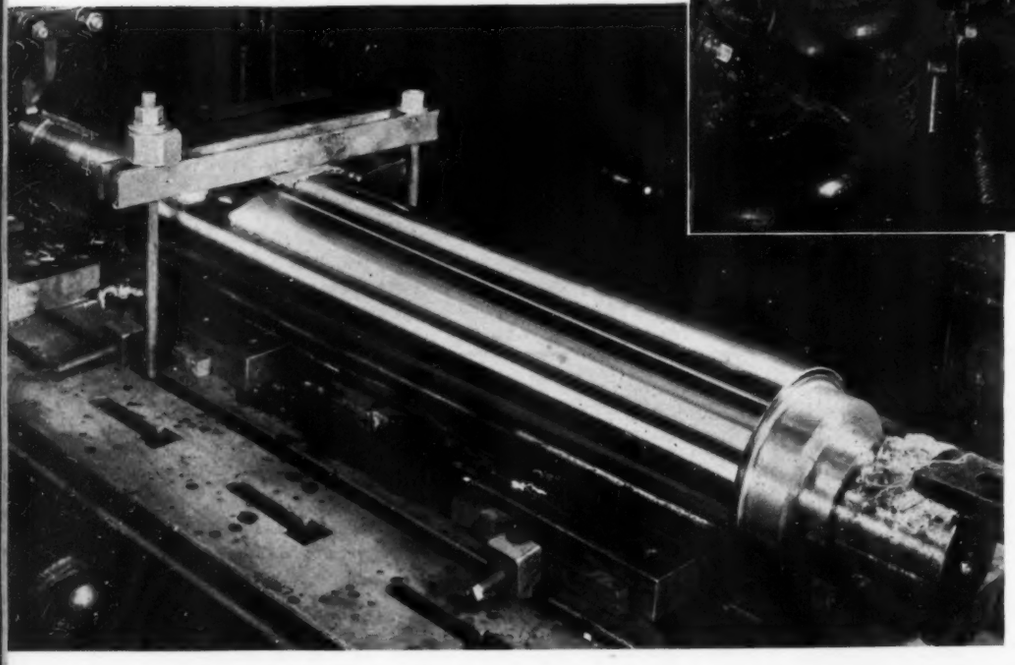


FIG.2

In a tin plate mill the work rolls in time become worn to a degree that they were formerly scrapped. Economy and the need for smaller tension rolls suggested the direct salvage of work rolls for this purpose. First the rolls of 0.85 percent carbon were annealed and then machined down to the dimensions of the smaller rolls, as shown below

Courtesy Wheeling Steel Corporation

With the new tension roll mounted in a lathe a circulating water bath was fabricated beneath the bed with welded plate. This allowed the roll to be half immersed in water during the hardening operation. The flame hardening apparatus was mounted on the cross-slide for use in the circular band progressive method



In hardening, additional quenches supplemented those in the integral heating and quenching tip. The entire circumference was hardened to approximately 90 scleroscope hardness to a depth of $\frac{1}{8}$ in. Time required was only two hours using a 4-in. wide tip requiring eleven complete revolutions of the 42-in. long surface

BIBLIOGRAPHY

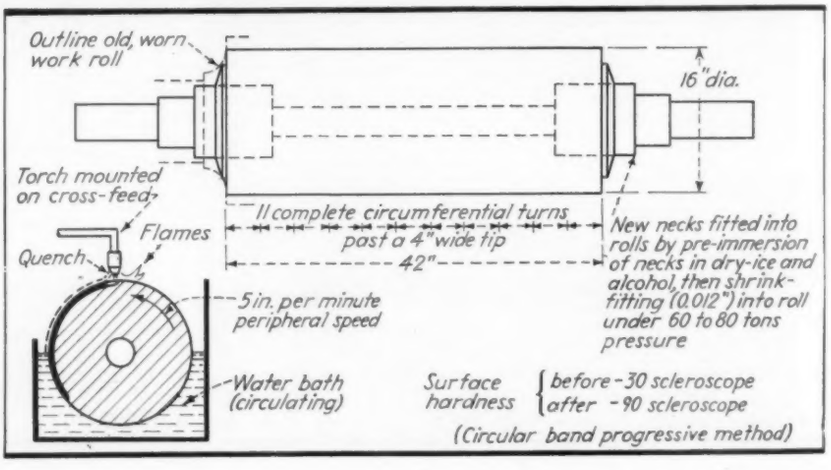
1. Flame Hardening, by Stephen Smith; presented A.S.M., Cincinnati, Ohio, April 20, 1939.

4. Notes on Flame Hardening, by G. V. Slottman, July, 1940.

8. Hardening Cast or Rolled Steel, by G. V. Slottman; *Steel*, November 9, 1936.

9. Hardening Iron and Steel with the Oxyacetylene Flame; by R. L. Rolf, *A.S.M. Metals Handbook*, 1936 Edition.

10. Localized Surface Hardening, by R. L. Rolf; *Steel*, November 30, 1936.


Outline old, worn work roll
16" dia.
Torch mounted on cross-feed
Flames
Quench
11 complete circumferential turns past a 4" wide tip
42"
New necks fitted into rolls by pre-immersion of necks in dry-ice and alcohol, then shrink-fitting (0.012") into roll under 60 to 80 tons pressure
5 in. per minute peripheral speed
Water bath (circulating)
Surface hardness
before - 30 scleroscope
after - 90 scleroscope
(Circular band progressive method)

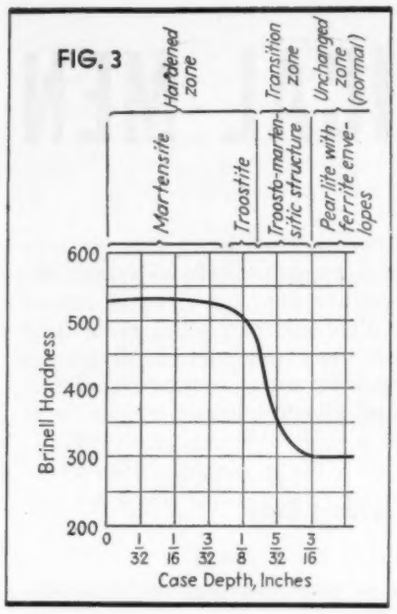


Table I—OXYACETYLENE FLAME HARDENING COSTS

Approximate* Depth of Hardness Penetration in Inches	Torch Travel Speed Per Min. in Inches	4-In. Tip Coverage Square In. Per Min.	Cu.Ft.** Acetylene Consumption Per Sq. In. of Surface	Cu.Ft.** Oxygen Consumption Per Sq. In. of Surface
5/16	2	8	0.55+	0.61−
1/4	3	12	0.37−	0.40+
3/16	4	16	0.28−	0.30+
1/8	5	20	0.22+	0.24+
1/16	6	24	0.18+	0.20+

* Depths subject to variation with the thickness of the object heated.
** Based on using 4 inch wide tip.
If a 3 inch wide tip is used — add 10 percent to gas consumption.
If " 2 " " " " " " 15 " " " " "
If " 1 " " " " " " 20 " " " " "
Other sizes proportionately.

Table II—TYPICAL PHYSICALS AFTER FLAME HARDENING

C	Mn	Cr	Ni	Mo	Elastic limit (psi)	Tensile (psi)	Izod impact (ft.-lb.)	Brinnell on core	Brinnell on surface
0.18	0.47	....	1.64	0.24	105,000	120,000	62	250	477
0.33	0.62	0.64	1.52	....	110,000	130,000	75	...	534
0.34	0.61	....	1.75	0.25	175,000	185,000	35	...	555
0.35	0.68	0.93	....	0.21	160,000	130,000	65	...	627
0.36	1.92	....	....	....	115,000	124,700	60	255	415
0.42	0.56	0.83	....	....	135,000	150,000	48	325	495
0.42	0.69	0.97	....	0.18	130,000	147,000	40	350	514
0.42	0.83	....	....	....	75,000	105,000	27	...	514
0.43	0.57	....	3.60	....	125,000	135,000	69	...	578
0.47	0.68	....	....	....	85,000	115,000	..	258	341

and quenching, and fully water-cooled. It has 33 No. 55 heating orifices, is operated at 14 lb. per sq. in. acetylene pressure on an acetylene consumption basis of 265 cu.ft. per hour, when adjusted to a neutral flame with oxygen in correct proportion: 1.10 cu.ft. of oxygen to 1 cu.ft. of acetylene.

Flame hardening employs the oxyacetylene flame as a heating medium in an operation analogous to furnace hardening, and involves no change in the chemical composition of the material, such as the introduction of carbon or nitrogen into the surface layers of the material as in case-hardening. In flame hardening a hardened wearing surface of shallow depth is obtained, and the necessary shock-resistant properties of the core are retained.

Temperature Varies With Carbon

Steels and certain cast irons are flame hardened by heating their surfaces above the Ac_3 transformation point, where the solid solution of iron carbide in gamma iron, austenite, is formed. The Ac_3 transformation point as well as the Ar_3 critical point (cooling) are variables dependent to a large degree upon the carbon content of the steel[8], as shown in Fig. 1. Consequently the hardening temperature range to which the metal must be heated, parallels the Ac_3 transformation point curve and is shown accordingly in compliance with Stead's upper and lower curves. As will be seen, Stead's lower curve indicates that the lower hardening temperature for 0.30 per cent carbon steel is about 1530 F. (the Ac_3 point is 1487 F.), whereas the lower hardening temperature for 0.70 per cent steel is about 1430 F. (the Ac_3 point is 1367 F.). Upon reaching the hardening temperature, the steel is rapidly quenched and the face centered gamma iron crystal is changed to a body centered iron crystal. The carbon originally present in the solid solution austenite is precipitated in the form of iron and other metallic carbides producing martensitic structures of considerable hardness.

The degree of hardness obtained in quenching given steels from temperatures above their Ac_3 transformation point is determined by the rate of quenching. At temperatures around 1000 F., the austenite of hypereutectoid steels transforms rapidly into a soft mixture of ferrite (iron) and the eutectoid pearlite (alternating layers of iron and Fe_3C crystals). When the transformation occurs at lower temperatures, around 350 F., the austenite transforms into the extremely hard phase martensite. This effect is indicated in Fig. 2.

The usual effect of the common alloying elements, carbon, manganese, silicon, chromium and nickel, is to displace the S curve to the right of the diagram. In general the common alloying ingredients in steel allow for obtaining a given degree of hardness with a milder quench than in the case of plain carbon steels.

In Fig. 3 is charted a typical flame hardened structure of a specimen of SAE 1035 steel. A direct comparison between depth and Brinell hardness is given and the pertaining metallographic structures are indicated.

Wear resistant surfaces are frequently subjected to either alternating or fluctuating loads. It is, therefore, of considerable importance to know the effect of flame hardening on the fatigue resistance or endurance limit of steel as treated. Endurance limit of steel generally improves in direct ratio to the ultimate strength which, in turn, is roughly proportionate to the hardness as commonly measured.[4] The tensile strength at the surface is increased in flame hardening, and as the maximum stresses are generally found at the surface, the fatigue strength is likewise increased by flame hardening.

Table II lists the tensile strength and other physical properties obtainable in flame hardening a group of ten steels. Each of the steels was first normalized, quenched, and tempered to the physical properties shown, and then flame hardened, the Brinell hardness numbers being determined on the flame hardened surface.[9]

Part 3 of this series will appear in an early number.

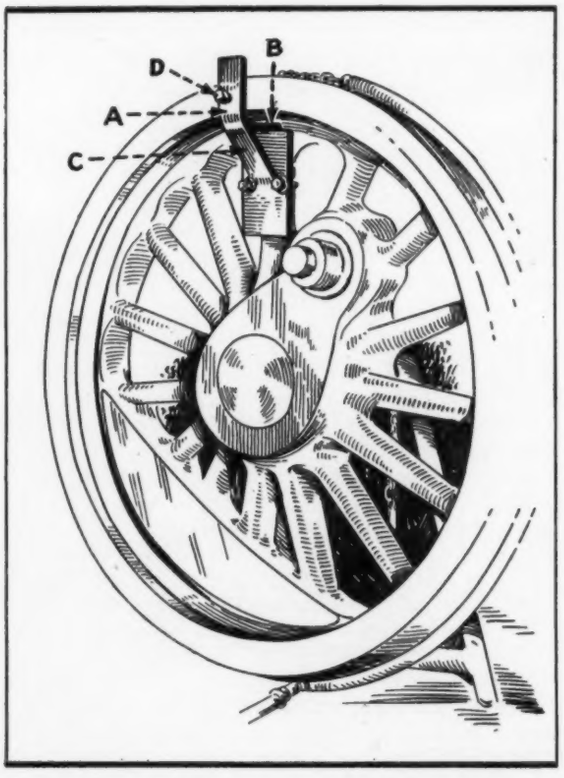
IDEAS FROM PRACTICAL MEN

Safety Hanger for Setting Locomotive Tires

BY ARTHUR HAVENS

It is customary when removing or applying locomotive tires, to sling a chain around the top of the wheel, either to hold the tire in place prior to setting, or to catch the tire after it has been expanded and driven off the wheel center. Rather than continue this practice, the tire setter in our shop devised the illustrated hanger.

This hanger was made from ¾ in. plate and bent at an angle as shown at *A*, so that the surface *B* would be flush with the surface of the wheel when bolted to the spoke. A supplementary brace *C* was welded in position.



This hanger, bolted to a wheel spoke, speeds the setting and removal of locomotive tires. Also, it is an ideal safety feature, since it prevents the tire from accidentally falling to the floor

As shown in the illustration, the tire sets on the hanger, and is adjusted laterally by set-screw *D*, so that the inside of the tire is flush with the outside of the wheel center. After expanding, it is a simple matter to drive the tire off of the hanger onto the wheel center.

When used on wheels from which tires are to be removed, the tire is expanded and driven onto the hanger. It is a positive stop, and under all circumstances will prevent the tire from falling to the floor. This has proved to be a very valuable device, not only because it speeds the setting and removal of tires, but also because of its safety feature.

Retainers for Knockout Rods

BY H. R. HAGEMAN

Compound pierce and blank dies equipped with one-piece knockout members having a stem passing through the punch holder shank are sometimes subject to serious and expensive damage by reason of the failure of the means employed to prevent their dropping out.

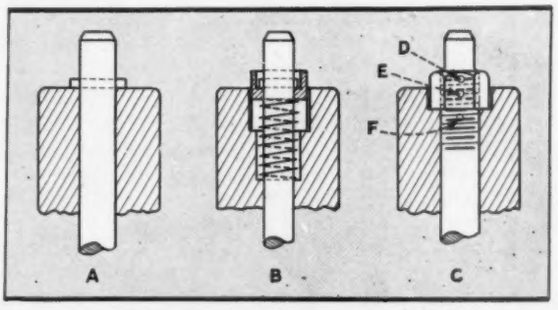
The most common means is a straight pin driven through the stem and protruding on each side, the length being limited by the dimensions of the slot in the press ram was the important provision for the knockout bar.

This method which is illustrated at *A* in the drawing while common is the most dangerous because the pins are likely to become loosened and jar out allowing the body of the knockout to come between the working faces of the punch and die.

In cases where the blank has an irregular outline so that the peripheral area is relatively great the knockout is likely to snap down so hard as to shear off the ends of the pin with the same disastrous results.

The method shown at *B* in the drawing is safe for light work since it positively prevents the pin falling out even though it is purposely made a loose fit in the stem.

A method which has proven reliable under almost any condition is shown at *C*. The cotter pin need not be more than 3/32 in. diameter as it merely pre-



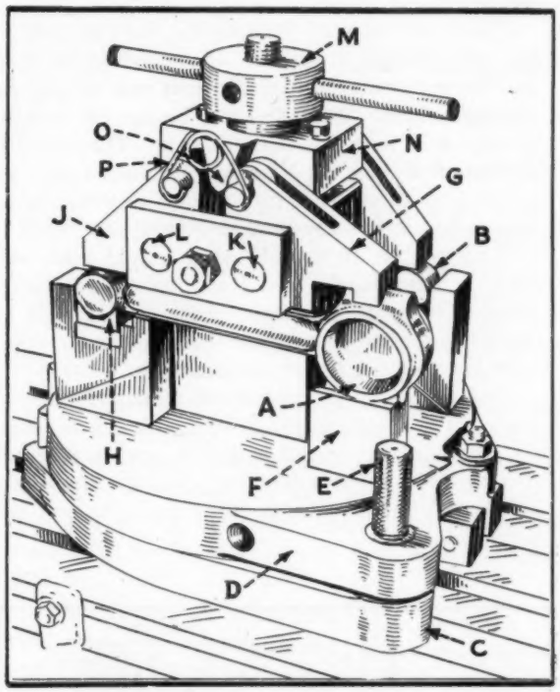
When conditions permit, the most reliable retainer for knock-out rods is a nut threaded on the rod and held in position by a small taper or cotter pin

vents the nut from turning and a row of holes *D*, *F* and *F* can be provided by which the amount the knockout extends below the die steel can be adjusted. The rod and nut should be cut with fine rather than coarse threads. As in the case of the cross pin the nut must be small enough to enter the slot in the ram.

Indexing Fixture for Connecting Rods

BY HARRY BLENMAN

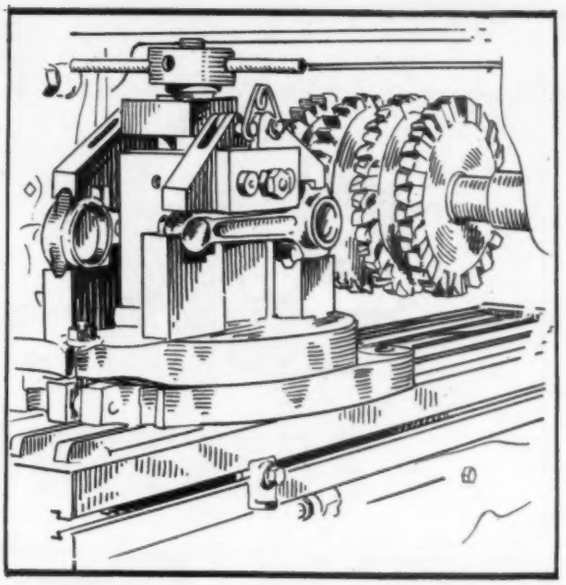
The illustrated fixture was designed for milling the crank boss and wrist pin boss of two airplane-engine connecting rods simultaneously on a universal milling machine. Rods *A* and *B* are set in the fixture so that the crank end of rod *A* and the wrist pin end of rod *B* are adjacent to the cutters on the arbor. When indexed 180 deg., the crank boss of rod *B*



This fixture can be indexed 180 deg. for milling two airplane engine connecting rods simultaneously. It replaced a fixture in which one rod was machined, thereby increasing production 50 per cent per machine

and the wrist pin boss of rod *A* come to the position shown in the drawing so that once the cutter set-up with the correct spacers for milling the sides of the bosses have been set up on the arbor, it is not necessary to change the set-up, except for sharpening the cutters.

The fixture consists of base *C* which is bolted to the table, the swiveling plate *D* and index pin *E*. The rods are clamped in solid V-blocks *F* and *G* at the crank boss end. The wrist pin ends of the rod rest in self-adjusting V-block *H*, which align the rod when pressure is exerted on clamp *J*.



The two cutters at the left mill the wrist-pin boss, while the two at the right mill the boss on the crank end of the second rod

Clamps *G* and *J* pivot about pins *K* and *L* respectively. Pressure is exerted on the clamp by the nut *M* when it is screwed down against block *N* which has tapered arms *O* that spread the arms *G* and *J*. The spring *P* prevents the clamps from dropping when nut *M* is loosened to remove and apply rods.

The wrist pin and crank boss faces of these rods must be milled parallel with each other. This fixture does this work accurately to the tolerances required for the airplane engine.

Prior to the use of this particular fixture, a solid one was used for milling one rod at a time. After this fixture was designed and built, necessitated by a step up in the production of the engines, production of the rods was increased 50 per cent per milling machine.

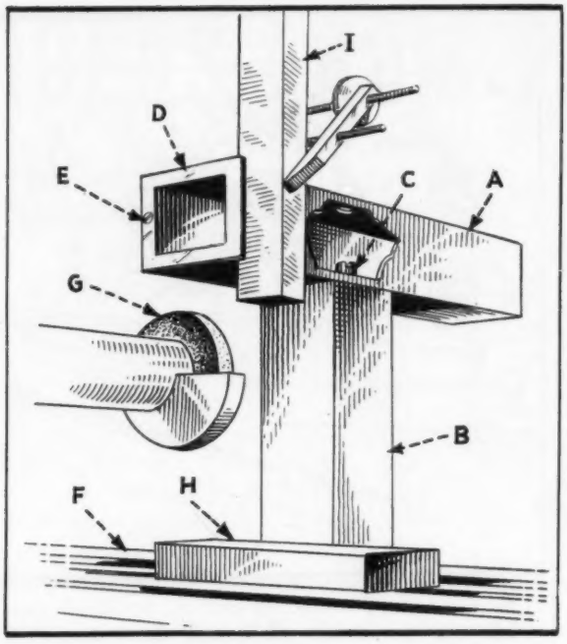
A fixture similar to the one described, is used on duplex milling machines for milling both sides of the crank bosses simultaneously, after which the table advances for milling both sides of the wrist pin boss, simultaneously. Both types of fixtures are now being used.

Built Up Parallels Aid In Grinding Long Work

BY S. J. PUTNAM

The illustrated fixture, built up from parallels, is held on a surface grinder by a permanent-magnet chuck. As the work passes over the wheel, rather than underneath it, the length of the work which can be ground is unlimited. All sides of the cast-iron parallels *A* and *B* are finished square to precise dimensions, about $2\frac{3}{4}$x3x11 in., with $\frac{1}{2}$ in. walls.

When used as a fixture for grinding ends of extra long parts, parallels *A* and *B* are fastened together with two cap screws *C* as shown. A flat ground plate *D* is fastened at one end of *A* with screws *E*.



This fixture, built up from cast-iron parallels, is held on a permanent magnet chuck, and is so designed that long work can be ground

This plate extends past one side of parallel *A* to provide means for holding the work square.

A hardened and ground parallel *H* is placed on the magnetic chuck *F* to give the built-up fixture extra base support, when parallel *B* is clamped against it.

The work *I*, which is to be ground on each end, is held in place by two clamps, one against the side of parallel *A* and one against the inside surface of the flate plate *D*; the latter is not shown.

With the machine in operation, the work passes forward and back over and above the grinding wheel, and the spindle head is raised until the wheel begins cutting. Cross feed is then used until the surface of the work has been cleaned up. By reversing the work in the fixture, the opposite end is ground to the overall length required.

Lead-Screw Tapping Makes Perfect Pipe Threads

BY LAURENCE F. SOUTHWICK

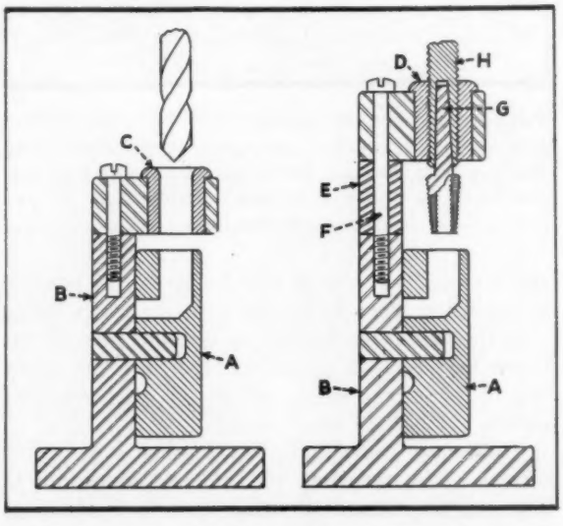
Anyone who has tried tapping pipe threads in a drill press with a tapping chuck—particularly one which is somewhat worn—knows how difficult it is to tap perfect threads. After the thread has been cut and the tap is started out, the space between the tap and the thread increases, owing to the taper, and there is less and less of the thread in contact with the tap. The operation of lifting the drill-press quill must be carried out with the greatest of skill. Even then it is almost impossible to avoid fouling the last one or two threads with the point of the tap as it emerges.

This problem was overcome by the use of a lead-screw between the tap and the tapping chuck as shown in the drawing. The work *A* was a brass casting, held in the jig *B* by a clamp not shown for take sake of clarity. The bushing shelf and bushing *C* were conventional, and used to drill the hole in the brass casting *A*.

To use the lead screw, the jig bushing *C* was pushed out and the threaded bronze bushing *D* with 18 threads per inch was inserted in its place. The space occupied by the tap was accounted for by a spacer block *E*, fastened to the jig body by long screws *F*. The shank *G* of the tap was ground to a No. 1 Morse tapper, driven hard into the lead screw *H* which was threaded for a distance equal to the travel of the tap plus the length of the bushing, plus a little more for good measure. The shank of the lead screw was made of the right diameter to fit conveniently into the tapping chuck, with a square end like a tap.

It may be observed by someone that the tap, in this arrangement, is guided rigidly, while the best lead-screw tapping practice demands that the tap be allowed to float. While this may be true for straight threads, it is false for taper threads. Theoretically, the instant a taper tap is backed, it comes free from its threads. Actually it may require a revolution or two to do so; but any float in a taper tap means it will ride out on the threads, while a rigid guide will bring it immediately free from the thread flanks. It must, however, run true; hence, the method of threading described, using the center in the tap point after inserting the tap in the lead screw blank.

Modification of the method of driving the tap, to allow it to float, is easy if desired. To do so, grind the tap shank cylindrical end to a smaller diameter than the hole in the lead screw; drive the tap with a hardened pin in a loosely-fitting hole through the tap shank.



A lead screw, guided by a threaded bushing in the jig, makes it possible to remove the ⅜-in. pipe tap from the work without damaging the thread

Armament

SECTION OF AMERICAN MACHINIST

HOW G. E. MAKES PACK HOWITZERS

The Erie Works uses modern methods to turn out an old weapon which has been redesigned to meet the needs of today's defense plans

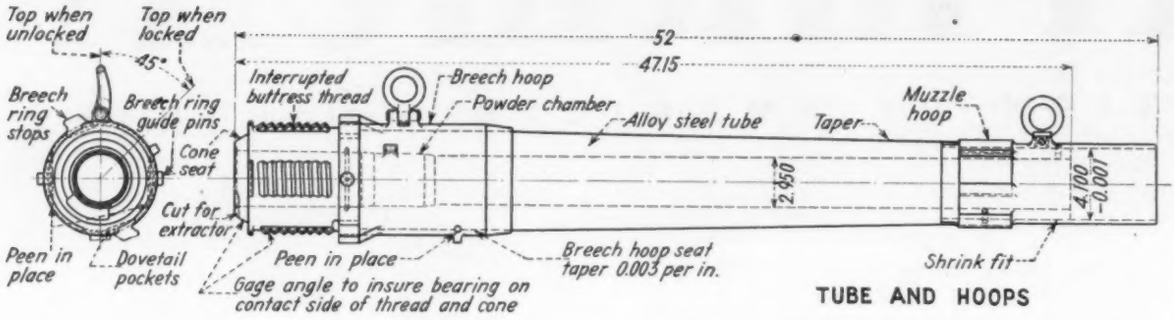
A PORTION OF the motor department of the Erie Works of the General Electric Company has been turned over to the manufacture of 75-mm. pack howitzers with marked success. For this purpose both old and new equipment are being used. Those machines which were adaptable to gun manufacture were tooled up for the howitzer operations; on the other hand some 50 per cent of the equipment employed is new. The result is current production at the rate of 35 howitzers a month.

Gun manufacture by the Erie Works marked a drastic departure from its peacetime production. Through the combined efforts of the plant management and the shop personnel the changeover was accomplished quickly while the exacting quality demands were met. The design of the 75-mm. pack howitzer is such that extremely careful workmanship is called for.

This weapon combines high striking power with a maximum degree of portability. Originally the howitzer was designed so that its major components could be carried on mule back which made it necessary to disassemble and reassemble the guns with ease and to have the parts fully interchangeable. These rigid requirements are still retained today. While the Army mule has yielded to mechanized units, it is not hard to visualize the value of this portable weapon when aerial transportation must be employed.

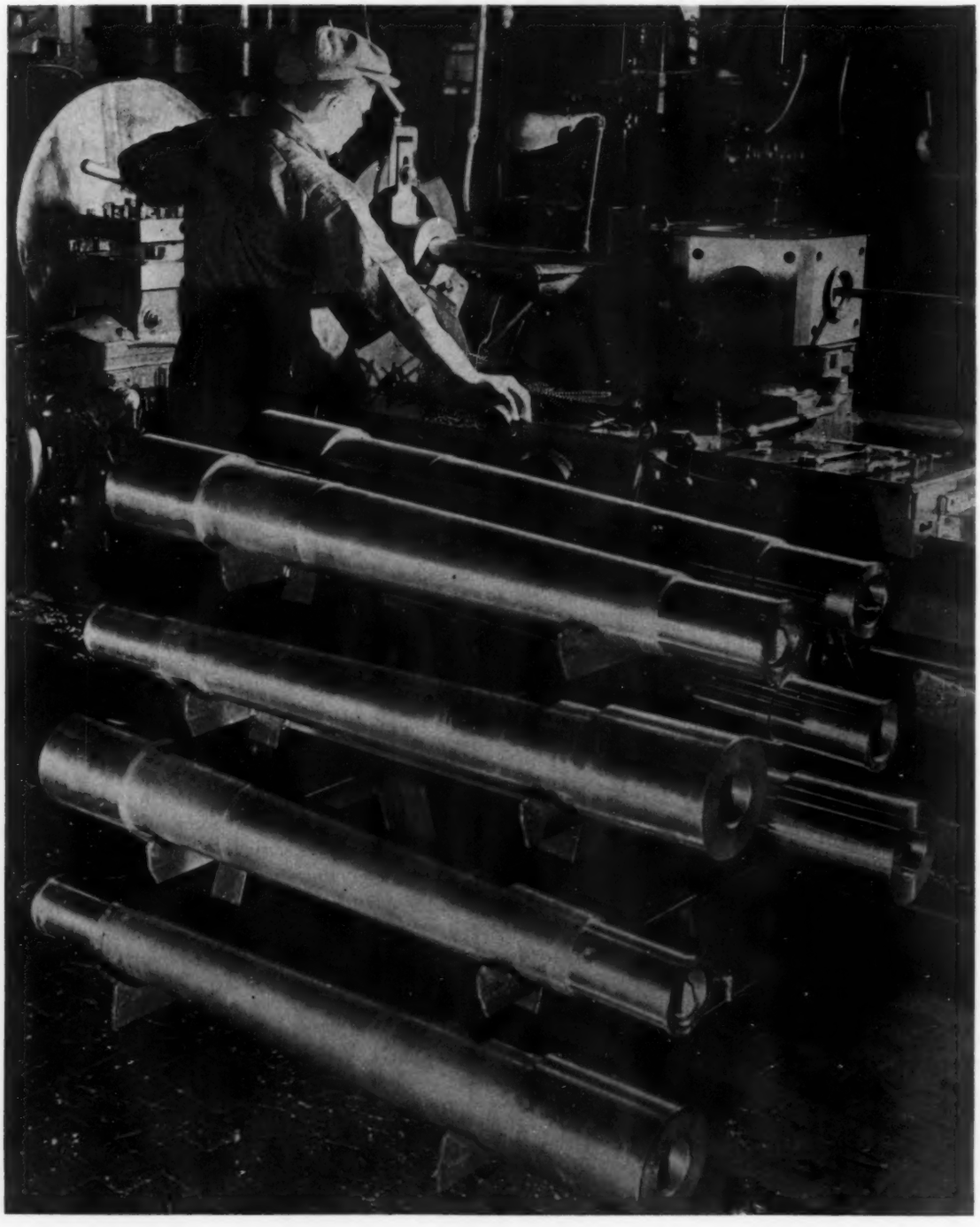
One of the final tests is to disassemble five guns and then reassemble them with the parts chosen at random. All this must be done without the use of tools of any kind. Assembled with its muzzle and breech hoops the gun tube weighs only 221 lb. The breech ring and breech block including the breech mechanism weigh 121 lb., bringing the total weight up to 342 lb. The 75-mm. pack howitzer has a range of approximately 9,500 yd. and throws a projectile weighing over 14 lb. It is said to have the highest striking power for its weight of any Army gun. The gun mount and the recuperator mechanism which make up the complete weapon are not manufactured at the Erie Works.

One of the major requirements in making the 75-mm. pack howitzer is to manufacture the parts so that they not only fit each other interchangeably but that they fit in a definite relation to each other. These fits are mutually dependent. For example, the breech hoop is a drive fit on the tube in a definite angular and longitudinal position. In turn the breech hoop determines the position of the breech ring by means of a



TUBE AND HOOPS

The Erie Works has adapted standard turret lathes to the boring operations on the 75-mm. howitzer. Here is shown the set-up for finish reaming the bore, and roughing and finishing the powder chamber



pair of stops. When the breech ring is screwed onto the tube it must contact a conical surface at the identical point that the stops meet. Then the breech block with its mechanism is fitted into the breech ring. Correct functioning demands that its relationship with the breech ring and with the other components be held precisely.

Smaller parts such as the firing pin body and the sear also involve exact machining and assembly operations. However, for the sake of simplicity the operations described in this article will be confined to four major parts: the *tube*, the *breech hoop*, the *breech ring* and the *breech block*.

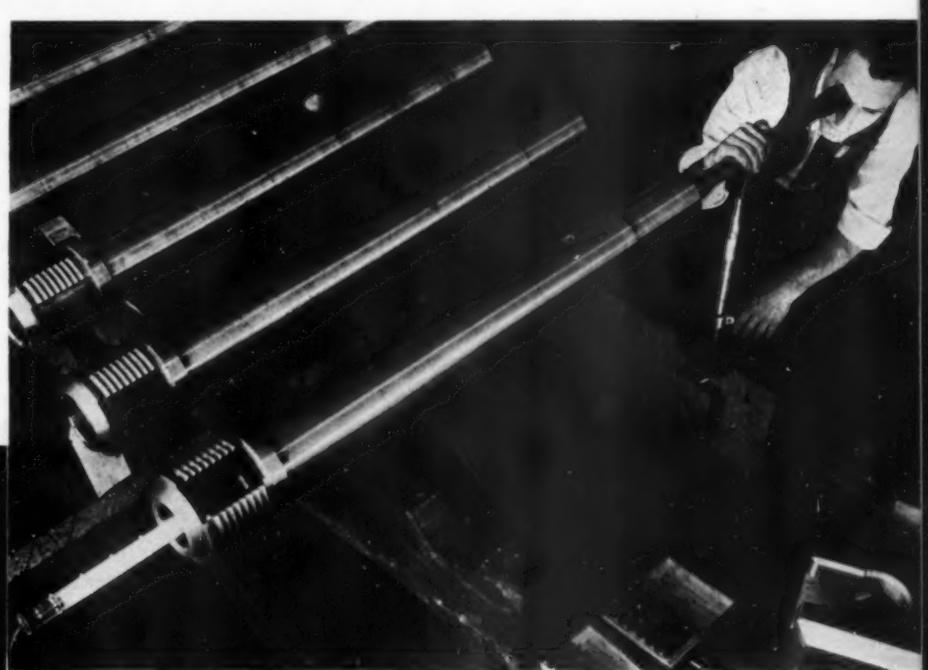
The tube forging, of carbon steel, is received already rough bored and turned. Fortunately, the 75-mm. howitzer is comparatively short (only 47 in. long) in comparison to its bore, so the boring operation can be done in Gisholt turret lathes already installed at the Erie works.

The first step is to insert the tube in a pot chuck in one of the turret lathes and to true up the end extending out of the chuck. Then a rough cut is taken through the bore to bring it to approximately $2\frac{3}{8}$ in. inside diameter and to remove the step which is left when the forging is rough drilled from both ends. The end is more accurately bored to 2.880 in. for a 4-in. depth to fit a plug on which the tube is supported during the turning operation, the outside diameter is spotted and the end is faced.

The tube is then reversed in the chuck while the other end is similarly bored and turned. In the turning operations the muzzle end is left oversize for a distance of about $\frac{3}{4}$ in. in order to leave a collar which is later used for indicating and chucking purposes. The chuck jaws are made to fit over the collar, thus holding the work securely axially as well as radially.

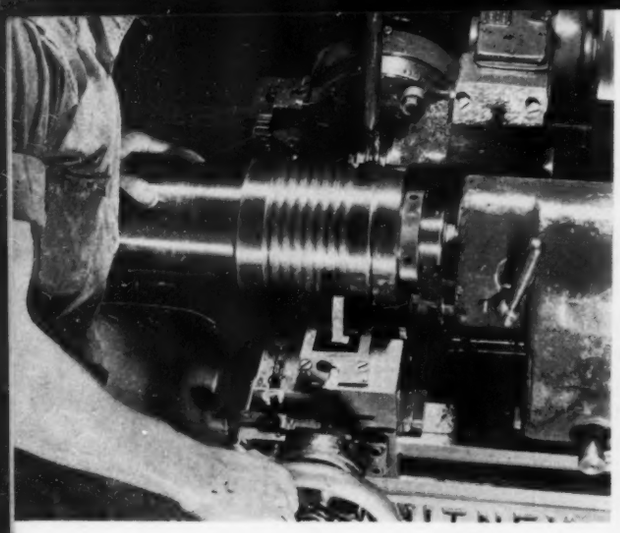
The tube is then mounted on center plugs and turned on the outside diameters leaving grinding allowance on the taper and on the breech hoop seat. These steps are done on an American engine lathe.

With the plugs still in the tube a Norton grinding machine grinds both ends to provide indicating surfaces for the boring and honing operations. At this point the tube goes back to one of the Gisholt turret lathes where the bore is rough and finish reamed. Rough reaming brings the bore to 2.90 in. and finish



The bore is honed in a special machine before and after rifling. Cutting lubricant is fed both through the tube and over the outside surface to keep the forging cool

Visual examination of the surface finish by means of a borescope is used on the honed bore and on the rifling grooves



Breech ring threads are milled with the tube mounted on center plugs. The size is checked with a thread snap gage. After the thread sectors have been cut, the tube is returned to remove the partial thread

Thread sectors are cut out on a shaper; a dividing head provided with a clamp which fits over the muzzle end of the tube has been adapted for indexing. For this work a gooseneck tool has been found best

reaming to 2.945 in. Wood-packed reamers are used with hard maple inserts impregnated with oil as described in a previous article. These reamers must be redressed after each use. For these operations, as for most steps on the howitzer parts, the cutting lubricant used is a two-to-one mixture of kerosene and white lard oil. After the straight bore has been finish reamed the powder chamber is machined in the same set-up. The chamber consists of a bore with a slight taper, a short beveled surface, a straight bore and another beveled surface which meets the gun bore proper. These surfaces are first roughed out with a single point tool and then rough and finish reamed with two wood-packed reamers. The reamers are piloted by means of bronze bushings which fit in the tube bore. A number of bushings are kept at the machine so the operator may select one which gives an exact fit. The finishing powder chamber reamer removes only about 0.002 in. of metal on a side. This work is done with the tube chucked in jaws on the lathe faceplate while the outer end is supported in a steadyrest. Powder chamber dimensions are checked with "go" and "not go" gages.

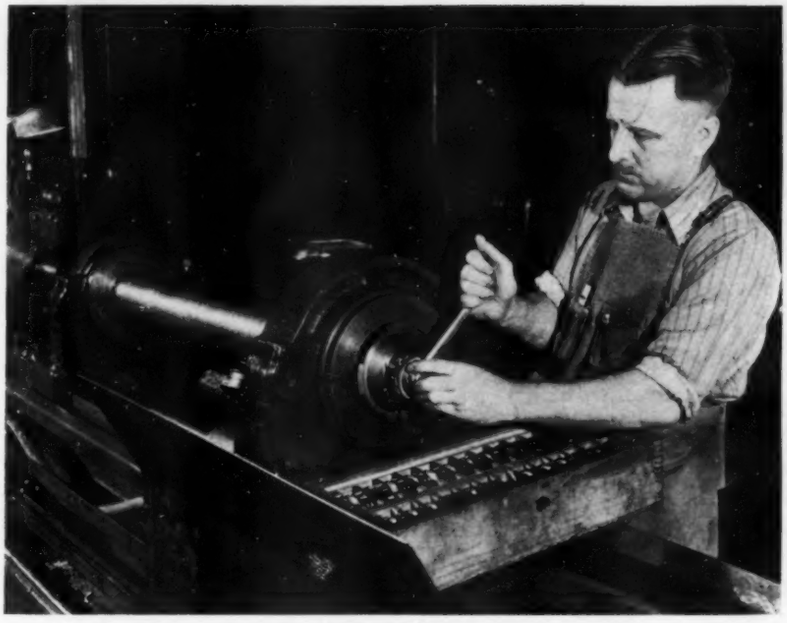
Next the tube goes to a W. F. & John Barnes honing machine which has been installed especially for work on the howitzers. The tube is carefully set up from spots previously ground on the outside diameter. It is honed to 2.9515 in. using roughing and finishing stones. Cutting lubricant is applied to the inside of the bore through the end opposite the tool and to the outside of the tube in order to prevent an excessive rise in temperature during the honing operation.

Before and after honing the bore is visually inspected with a bore search or borescope. This instrument consists of a tube which extends into the bore and carries a mirror at the far end which reflects an image of the surface into a microscope. The surface is illuminated by an electric lamp fastened near the mirror and is magnified twenty times in order that any defects in the surface may be evident.

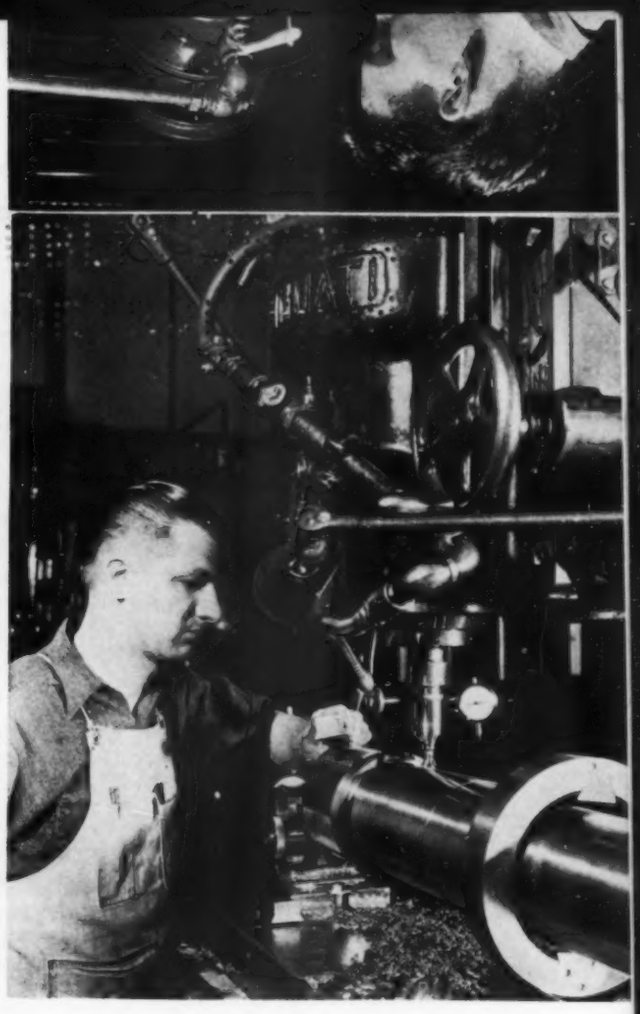
Star Gage Used on Bore

After the honing operation a star gage inspection is also made. The star gage has three points which can be adjusted to come in contact with the inside surface of the bore; two points are fixed while one is moved by means of a vernier micrometer at the outer end of the gage. A large magnifying glass is provided so that the vernier reading can be read clearly. With two points of the star gage up and one point down, readings are taken every inch of the bore starting at the muzzle end; then the star points are reversed and a reading is taken every five inches moving the instrument in the opposite direction. The outer end of the star gage is supported on a roller rest to keep it in a horizontal position.

After inspection the tube goes back to the machining department and is again mounted on center plugs for turning in an American engine lathe. All shoulders



Twenty-six broaching disks are used for rifling. Here the operator is shown removing a disk after it has been pushed through the bore. The broach box is not kept in this position as it would fill with cutting oil



Exact location of the dovetail is maintained in relation to the thread sectors. The cut taken by the formed end mill is checked with a gage block, while the ring gage at the right is used as a final test

are cut and the outside diameters are turned for grinding. However, some stock is left on the shoulders and on the end of the tube so it is possible to make an adjustment if any of the surfaces are found to be incorrect.

Straight surfaces are then rough and finish ground in a Cincinnati grinder leaving 0.010 in. on the muzzle hoop surface and 0.002 in. on the opposite end. These surfaces are used in setting up the tube in the rifling machine. Other surfaces ground in a Cincinnati machine are the taper surface and the breech hoop surface.

The thread for the breech ring is then rough and finish milled in a Pratt & Whitney thread milling machine. The thread has a special buttress shape into which the breech ring fits in such a way as to give maximum resistance to the force of the propelling charge of the shell when the gun is fired.

Thread Determines Center Line

Up until this point no attention has been paid to the angular position of the tube; since the tube is entirely symmetrical, the thread can be cut beginning at any point on its circumference. However, once the thread is cut it is essential to locate a center line for setting up the tube in subsequent operations. This is done by means of a thread location gage which is fitted to the tube from a centerline layout on a blue vitrioled surface to make sure of a good fit. With the gage on

breech end and muzzle hoop surface. Right and left sides are indicated so that the tube will not be accidentally inverted.

Since the design of the tube calls for an interrupted thread it is necessary to cut out sectors of the thread. This work is done in an Ohio shaper using a gooseneck tool. The breech end is mounted on a plug, while the muzzle end if held by a welded clamp secured to the face of a dividing head. The shaper tool cuts away the unwanted portions of the thread while the tube is indexed by hand. Then the work is returned to the Pratt & Whitney thread miller for removing the part thread left in the shaping operation.

The cone seat is then rough and finish turned in an American engine lathe. This surface determines the point of contact when the tube is assembled with the breech ring. Hence it is gaged accurately with an angle ring gage and a ring thread location gage.

The rifling operation comes next. This is done in a LeBlond hydraulic machine which uses the broaching process. Before the tube is mounted in this machine it is demagnetized as a precaution against the lodging of chips where they may cause damage. The broaching disks are pushed through the tube, beginning at the muzzle end and are removed at the breech end before the bar is returned to the starting position. Twenty-six broaching tools are used each of which is mounted in sequence on a special head through which cutting

drive the chips ahead of the tool and prevent scoring the rifling grooves. These disks cut alternate grooves, that is, 14 of the 28 called for in this design. After the first 14 rifling grooves are cut the tube is indexed so intermediate grooves may be cut by the same process. The purpose of cutting only half the grooves at one time is to operate the machine well below its rated capacity in order to insure ample power to obtain freedom from vibration and chatter marks. Broaching disks are good for about 25 gun tubes between grinds.

After rifling another inspection follows, using the borescope and the star gage. The borescope visual inspection is similar to that used prior to rifling, but for this inspection the star gage has four points, two of which are adjustable and touch the bottoms of the grooves while the other two are fixed and ride through the grooves at 45-deg. angles to the adjustable points. Each pair of grooves is inspected for size every five inches along the length of the tube.

The tube is then faced to length by taking a cut on the muzzle end and on the shoulders as required. This extra stock makes it possible to adjust any error that may be discovered without spoiling the forging. Center plugs are again used for this operation.

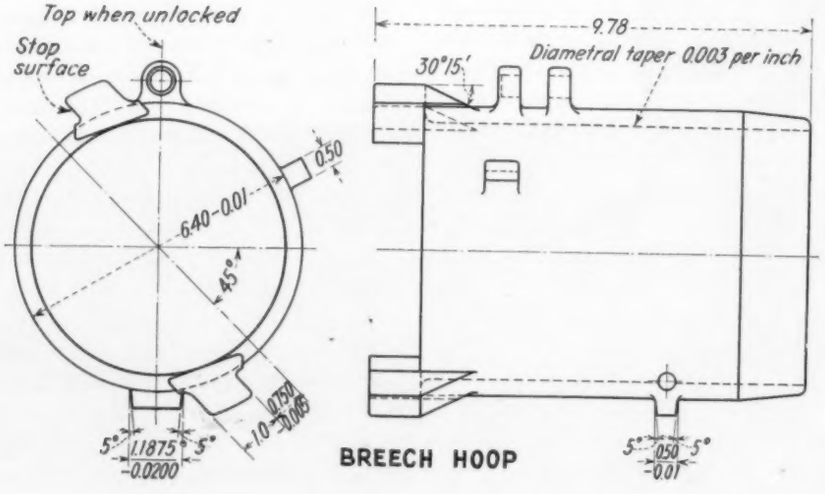
The design of the howitzer calls for drilling and reaming stud holes through the cylindrical surface of the tube at an angle. In order to do this work it is necessary to take some precaution to avoid the danger of drill run-out. A sacrifice plug is used to keep these holes straight. In the drill jig bushing, a steel plug, square at one end and curved at the other, is placed to fit the outside surface of the tube against which it is pressed tightly by means of a setscrew. The drill cuts through this plug and when it meets the surface of the tube it is cutting metal on all sides. The plug is wasted as each hole is drilled, but good alignment is assured. Reaming is done with a hog-nose tool, that is, one having a straight end somewhat like an end mill with only one lip.

Next dovetail pockets are cut in the breech end of the tube to provide location for the breech hoop. The work is done in a Cincinnati vertical milling machine with the tube mounted on center plugs supported by a dividing head at one end. A special formed end mill is used, and the tube is positioned angularly from the interrupted thread. Accuracy is assured by the use of special gages. In the same set-up a small groove known as the extractor pocket is machined.

As an added precaution before the tube is sent to assembly, it is again put in the honing machine and a small amount of stock removed from the lands between the rifling grooves. This operation has been found well worth the time it takes because in addition to straightening and sizing the bore it removes any feather edges that may be formed in rifling. Tubes are also given a hand honing operation on the assembly floor if it is deemed desirable.

In all machining steps on the howitzer components, it is necessary to transfer heat numbers from time to time. As these numbers are used to identify the part from the rough forging to final assembly, it is a rule that an Army inspector must be present when a number is transferred. All parts are carefully hand finished to remove burrs and smooth sharp corners before assembly. Portable tools are extensively used to expedite this work.

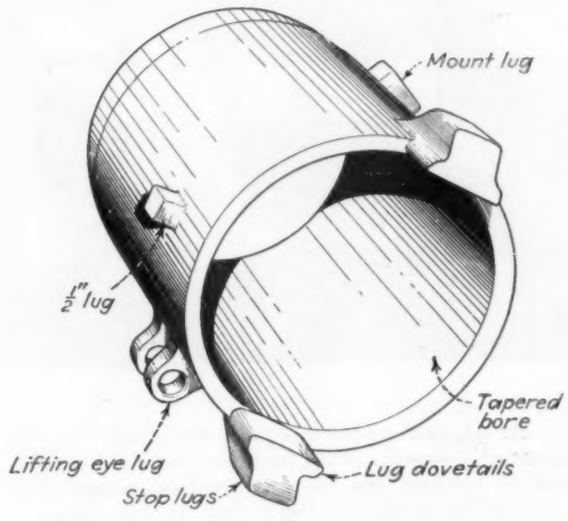
The tube assembly consists of the machined forging just described together with two hoops known respectively as the muzzle hoop and the breech hoop. The muzzle hoop is shrunk on. In order to make this fit

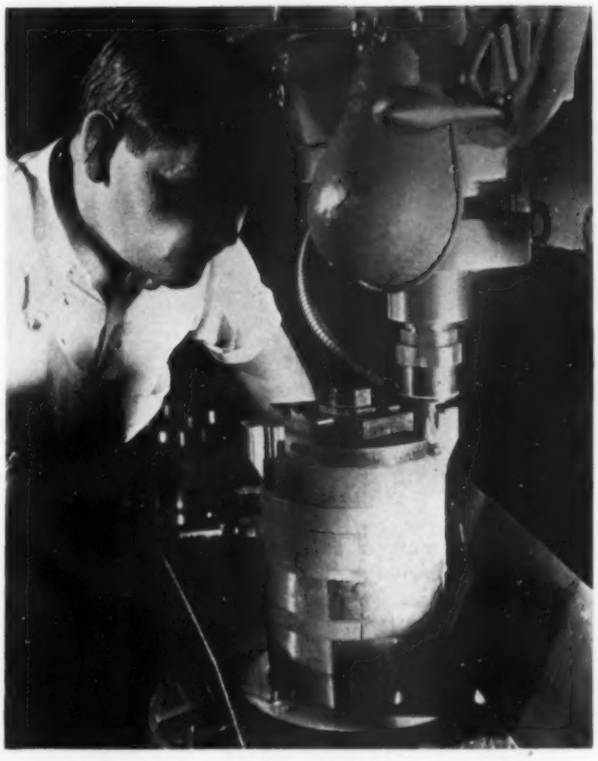


BREECH HOOP

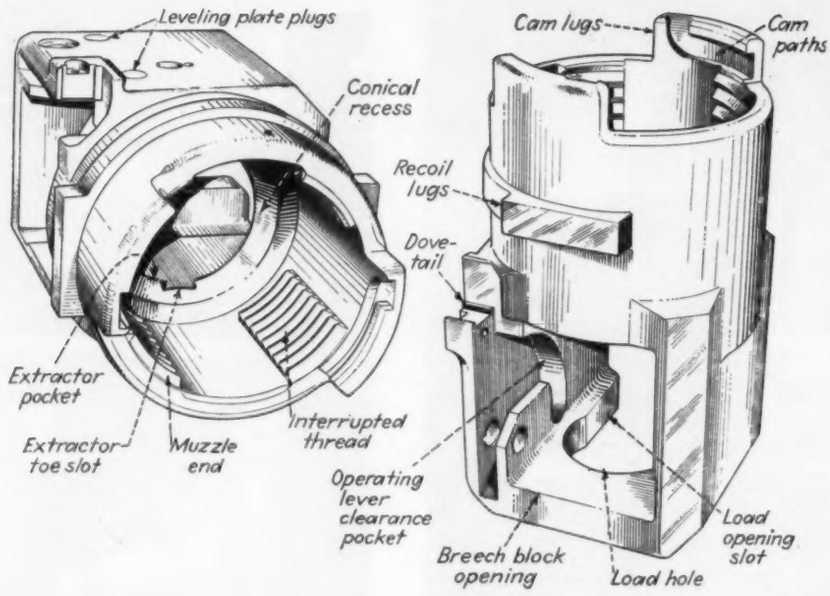
Since all lugs on the breech hoop are integral with the forging, they are first turned as rings; then the extra metal is removed in a series of slotting operations. In the foreground is a hoop before slotting

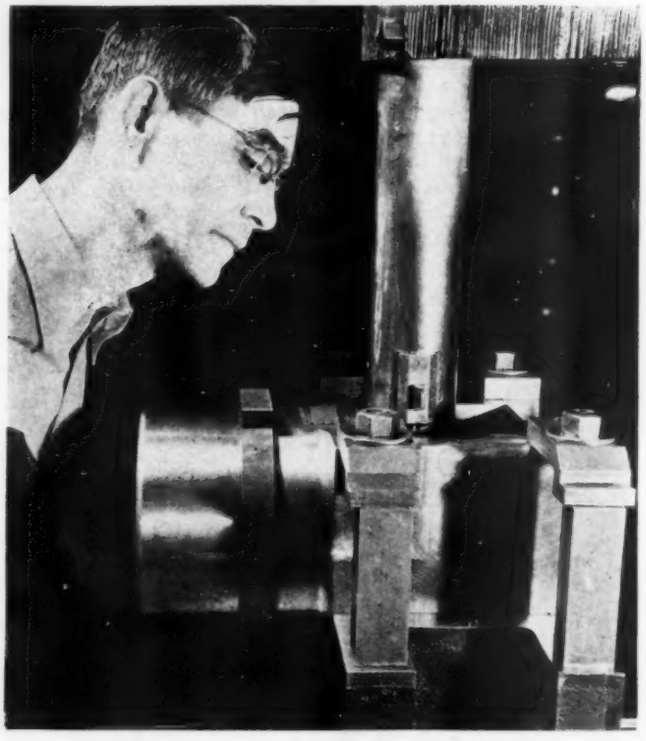
Faces of the stop lugs are machined in a horizontal milling machine with the breech hoop mounted on an arbor positioned with an indexing plate and pin. The work is offset to give the proper angle on the lug





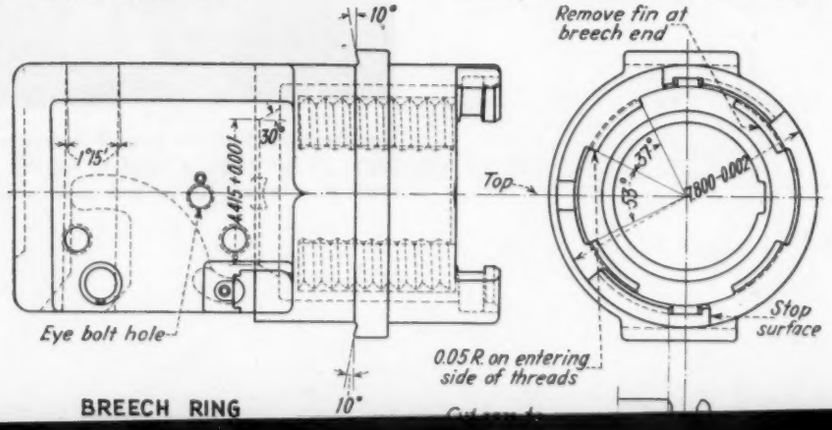
Dovetails position the breech hoops in relation to the tube. A set gage is used to fix the position of the work in relation to an end mill to obtain accuracy





The exterior outline, all radii, and the load opening slot are milled in a horizontal boring, milling and drilling machine. The work is located on a plug from surfaces previously bored

The breech block opening is cut in the breech ring by means of a slotter. After roughing and finishing the straight surfaces, the block is tilted by means of a wedge for machining the 1 deg. 15 min. angle



BREECH RING

the muzzle hoop is made 0.0025 in. smaller in the bore than the mating ground surface on the tube. The hoop is placed in an electric furnace and heated to 500 F. for one hour. Then it is slipped over the tube and cooled with water while it shrinks in place.

The breech hoop is a drive fit on the tube. It is made from a carbon steel forging rough turned and bored. There are a number of lugs on the outside of the breech hoop which according to Army specifications must be integral with the hoop forging making it necessary to machine them out of the solid. In order to do this the forging is turned with a number of rings left at points along the axis where the lugs are located.

The first operation is to chuck the breech end of the forging in a Warner & Swasey turret lathe while it is turned, faced and bored. Then the workpiece is reversed, end for end, and corresponding operations are performed on the breech end previously held in the chuck. A third turret lathe operation does the finish turning on the rings from which the lugs are formed. In order to establish angular location for this piece, which up to now has been symmetrical, a $\frac{9}{16}$-in. slot is milled central with the top of the $\frac{1}{2}$-in. lug using a Cincinnati horizontal milling machine. Other operations in the same machine mill the mount lug to height and then straddle mill to form the sides and radii.

Lugs Formed by Slotting

Then follow a series of slotting operations, using Pratt & Whitney machines, in which the rings are entirely removed except for the lugs. These slotting operations are interspersed with straddle milling cuts to form the sides of the lug and eventually get the hoop down to its proper diameter. The hoop then goes to an Acme turret lathe to turn the stop lugs to angles of 30 deg. 15 min. including the radius that blends into the outside diameter of the hoop. Then the work is chucked on the table of a Bullard vertical turret lathe where it is bored and taper ground using a portable grinding head on the tool ram. It is this surface that matches the tube when the hoop is assembled with a drive fit, and hence it must be accurate as to size and taper.

The dovetails are then cut in the end lugs with the work mounted on a plug on the table of a Cincinnati vertical milling machine. Since these surfaces determine the angular position of the hoop in relation to the tube they are cut using a set gage, the faces of which, having the same angles as the dovetails, are used to set the work in relation to an end mill.

The stop lugs are then milled in a Cincinnati horizontal milling machine. In order to realize the importance of these surfaces the method of assembly between the breech ring, the hoop and the tube must be remembered. The breech ring is threaded to fit the tube and has a conical recess that fits the conical end surface of the tube. The thread and conical surfaces must fit snugly but not so tightly that they will become jammed during assembly. It must be borne in mind that these parts must be disassembled without the use of tools. In order to prevent jamming, stop lugs are placed on the breech hoop to match projections on the breech ring to limit the amount the breech ring can be rotated.

If the ring is threaded slowly on the tube during assembly and all fits are accurate, the locating points on the ring will be open about $\frac{1}{8}$ in. from the lugs on the hoop when the conical surfaces seat. If, however, the ring be given a slight spin, the inertia of its weight will close this gap without the application of any other pressure. An assembly pressure of from 8 to 10 lb. is desired, and this spin is ample to supply it. Assembled in this fashion the breech ring should fit the tube at the conical surface with an 85 per cent bearing as indicated by Prussian blue. Thus a snug fit is obtained which at the same time permits the gun crew to disassemble the ring from the tube by hand as called for in the Army specifications.

In order to position the stop lug faces properly, the hoop is mounted on a horizontal arbor with angular adjustment fixed by means of a locating hole and a stop pin. In this fixture the lug on one side is milled with a form cutter in order to supply the radius, and then the work is indexed 180 deg. to machine the opposite lug. These lugs are cut in an off-center position to supply the angle called for in the design of this part.

Additional operations on the breech hoop consist in milling and slotting radii between and around the lugs, and in drilling and reaming the holes in which the lifting eye is fastened.

Breech Ring Calls for Fine Workmanship

The breech ring involves some of the most ticklish operations on the entire howitzer. It is made of an alloy steel forging, and is received rough machined. The first operations are done conventionally enough on Gisholt lathes. The forging is chucked first on one end, then on the other while it is faced, turned and bored on the various inside and outside diameters, including the important conical recess that later determines the fit to the gun tube. As in other turning operations on howitzer parts, tungsten carbide tools are employed wherever practicable.

Since this forging is not symmetrical, it is important to locate the work properly. A pot chuck is used to hold the work while the muzzle end operations are performed. Then a boring fixture holds the piece while the load hole is bored and the breech end faced. A center line is then scribed on the piece.

Next the breech ring is clamped, muzzle end down, over a plug on the table of a Giddings & Lewis hori-

zontal boring, drilling and milling machine, while the exterior outline, all radii and the load opening slot are milled. Special form mills are required for the radii.

Four slotting operations follow. Using locating plates on the breech face, the recoil lugs are outlined and the metal between them removed. Then, using a cradle fixture, the breech block opening is rough and finish slotted.

Since one face of the opening is 1 deg. 15 min. out of line with the others, it is necessary to tilt the block in order to slot this face. This is done by means of a wedge which is placed under the fixture. The 10-deg. angles and the radii on the recoil lug are then milled in two set-ups using vertical milling machines.

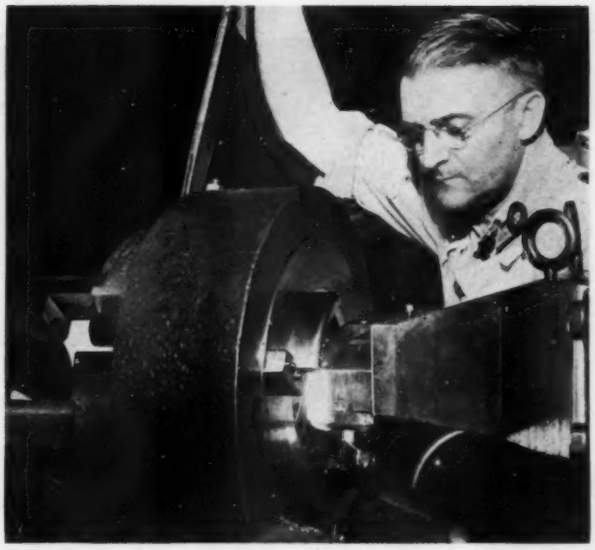
At this point two blind holes are drilled and reamed using hog-nose tools and then undercut. These holes provide anchors for two soft metal plugs which are peened into them. These plugs supply supporting points for the leveling plate used in sighting the howitzer when in use. They are later machined, engraved with double cross lines to insure alignment between the instrument and the gun tube, and are hand-scraped to get them exactly level with the bore.

Inside the breech block opening there are two radial slots and in order to reach them, a special milling head is required. One of these forms the clearance pocket for the operating lever. Using Cincinnati horizontal machines and a right-angle cutter arm driven through helical gears, it is possible to reach this slot from the side of the breech block opening. The work is mounted on a circular table and swung around in an arc as the metal is cut. A number of cuts are taken with an end mill in order to form the pocket to its proper width. A similar but shorter slot, which forms the extractor pocket on the opposite inside face of the breech block opening, is similarly machined using the same milling head.

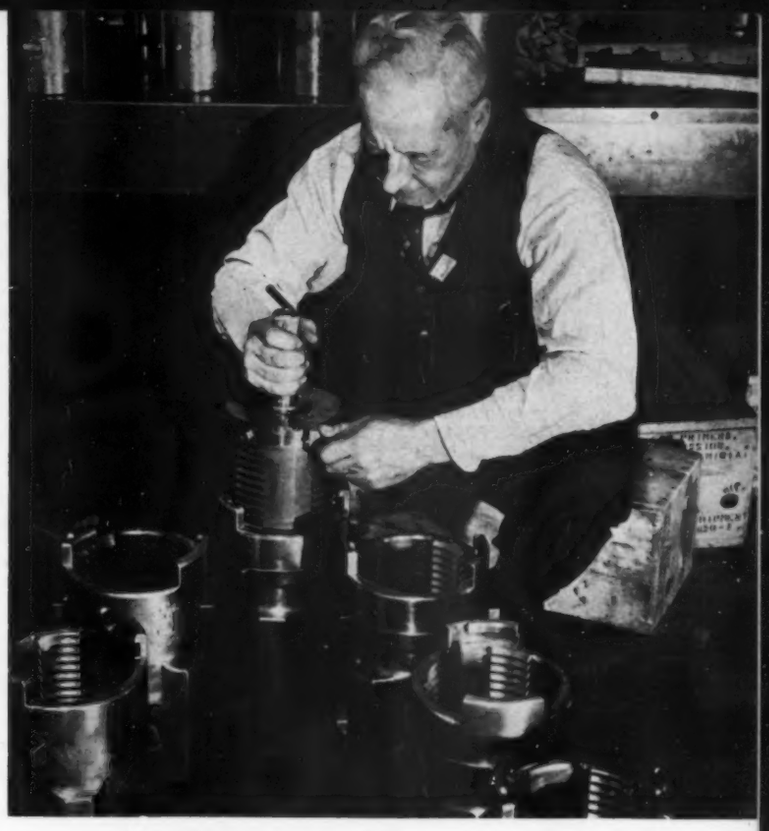
The most exacting job on the breech ring is to bore and counterbore the thread surface, cut the 30-deg. angular recess and cut the thread itself. It has already been explained that the position of the threads in relation to the recessed conical surface must be precisely machined in order to have the breech ring fit the gun tube satisfactorily. When the conical surface of the breech ring meets the mating surface of the gun tube in assembly, the angular position of the ring must be such that its spot lugs meet those on the breech hoop, with an 8- to 10-lb. pressure. The lead of the buttress thread is such that there is a ratio of 43 to 1 between the longitudinal distance along the axis and the angu-

A special cutter head reaches into the square opening of the breech ring to machine the radius for the operating lever pocket. The circular table controls the path of the work in relation to the cutter

In this set-up, the breech ring is bored, counterbored, the conical recess finished and the thread cut. Note the indicators to position the work and the tool slides, the thread limit gage on top of the compound rest and the thread set gage at the lower right



Rotating cam paths guide the breech ring when assembled to the tube. They are cut by using a right angle milling head. The work is fed axially into the cutter and then rotated along a helical path through the use of a special fixture



Breech rings are inspected by using a special gage which checks the conical recess, the thread, the stops and the cam paths simultaneously

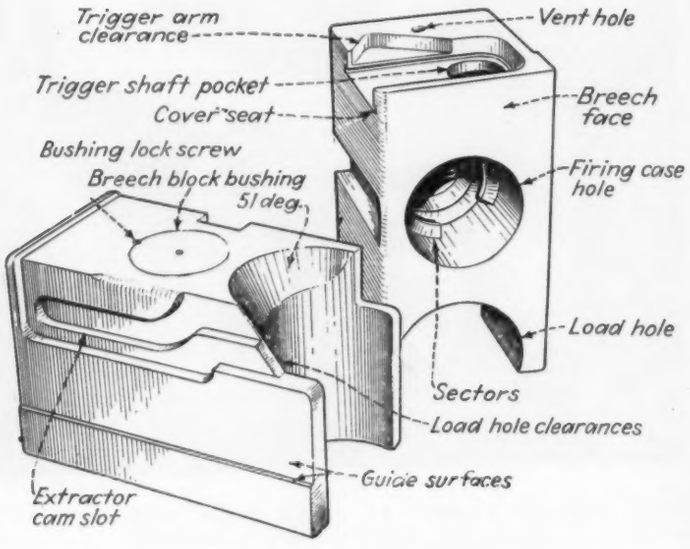
lar movement of the contact point when the breech ring is rotated. This ratio means that if the conical recess and the thread are 0.001 in. out of position with each other axially, the angular location of the lugs will be off by 0.043 in.

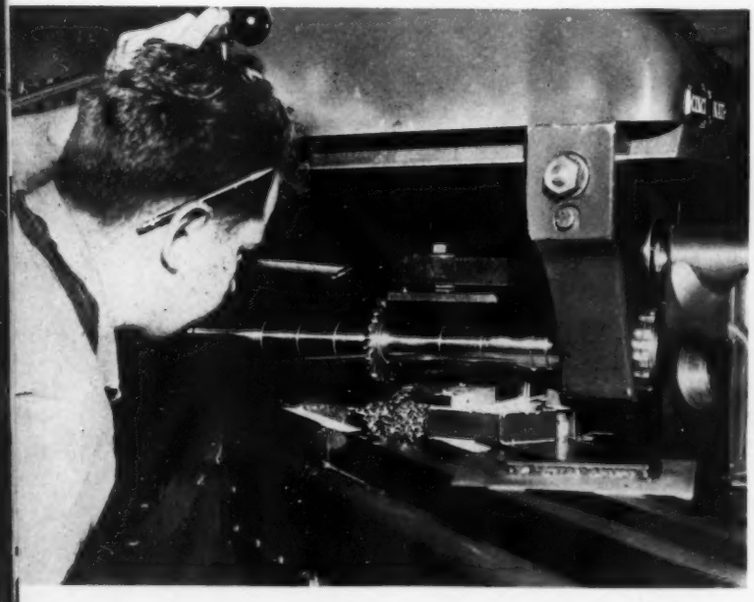
The machining operations ares performed in an American engine lathe with the breech ring carefully positioned in a fixture that is open between clamping points to permit gaging through the breech block opening. The workpiece is trued up by using an indicator on the outside diameter. Then it is bored, counterbored and the 30-deg. conical recess is machined and located from the adjacent surface of the breech block opening by means of a plug gage which fits the cone to a depth which brings it flush with the surface. A positioning gage is used to locate the threading tool. It locates from the same breech block opening surface and extends through the bore. The tool is set into a V notched into this gage. In addition to the other difficulties of this job, the thread must be cut in a blind hole; to stop the tool accurately, a dial indicator is mounted on the carriage in such a way that it strikes a stop when the proper depth has been reached.

As the thread is chased out in a series of cuts, it is checked by means of a special roller thread gage. This gage fits the thread by the contact of two multiple V-rollers which are forced apart by means of springs. Each half of the gage has a locating point so positioned that a gage block can be placed between them. The block has a step in it, making one end larger than the other, and when placed between the locating points gives the "go" and "not go" positions of the thread sections. The locating gage which has been used to set up the threading tool also has a male V which fits between the threads to check their position when the breech ring centerline is set horizontally. From time to time, during the threading operation the thread position is checked until only a few thousandths remain for the final cut. Then the whole job is rechecked with a special plug gage which carries a threaded section and a cone to simulate the correct dimensions of the gun tube itself.

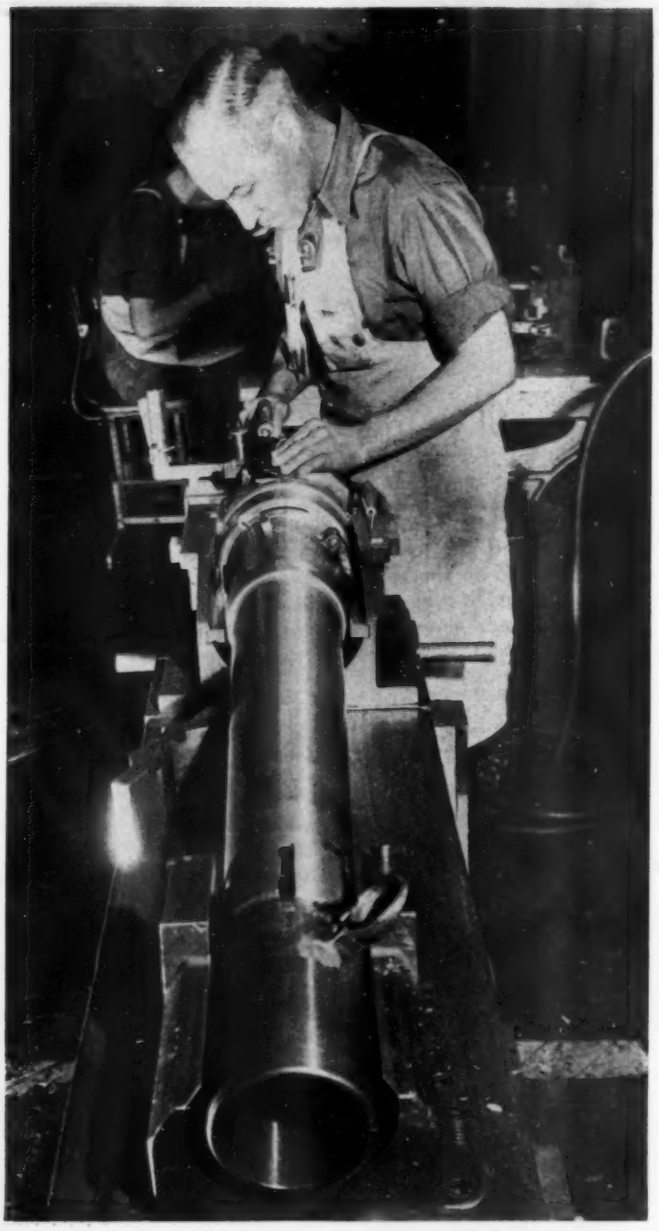
A small slot is then machined inside the breech block opening as clearance for the extractor toe, using a Norton keyseater. The extractor is a pivoted arm that removes the shell case after firing, and this slot allows the toe to remain flush with the inside face of the breech ring so the shell will fit squarely until the extractor is operated.

The cam lugs on the muzzle end are then form milled. It should be explained that in order to make sure that the assembly between the breech ring and the

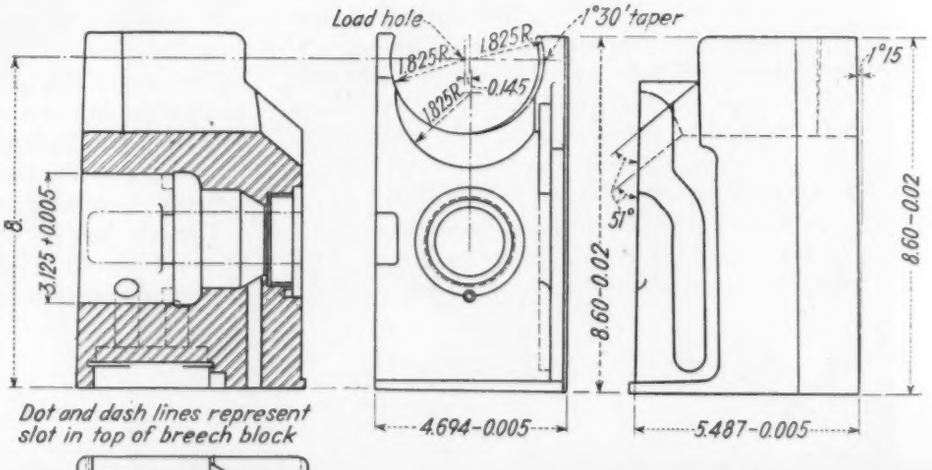




Clearance is milled in the breech block load hole in a horizontal milling machine. After the right-angle cut has been taken the block is fed at an angle of 51 deg. Note that the axis of the cutter in relation to the block is not changed



Two spots on the breech ring provide a surface for the leveling plate used in sighting the gun. They are carefully scraped with the breech ring assembled to the tube and supported by a fixture which simulates a gun carriage



tube is foolproof and that the threaded segments cannot possibly be started in a wrong position, the breech ring is guided by lugs in which are cut cam paths that fit over locating pins on the tube. These paths start out axially and then turn to follow the same lead as the threads of the breech ring. To make sure that the position of the lug cannot be reversed in fitting the ring to the tube, the pin that enters one path is larger than that which enters the other. When the ring is assembled to the tube, the cam paths follow the pins and guide the threads into engagement with those on the gun tube. This arrangement insures that the thread sectors will match and also avoids the possibility of butting the ends of the threads against each other during assembly which would be likely to create burrs that would destroy a good fit.

Fixture Controls Shape of Cam Paths

To mill the rotating cam paths, a special fixture is used on a Cincinnati horizontal milling machine. The paths are cut by means of end mills. The fixture is moved on a sliding base so that the ring travels axially into the cut. Then a handle is turned manually so that the work-holding section of the fixture is rotated. This section is fitted to the outer frame by means of threads which have the desired lead. As the breech block held within the fixture is rotated, a lead is formed in the cam path which corresponds to that built into the fixture which, in turn, is identical to that of the threaded portion of the breech ring.

Next a series of operations is performed on horizontal milling machines which chamfer angles on the side corners, the breech face and the load opening. Still another series of steps are taken on Pratt & Whitney slotters. These consist of slotting the sectors, clearances for the operating lever, the catch seat and the dovetail.

The slotting operations are followed by a number of other set-ups in vertical milling machines which have for their general purpose the removal of excess metal and the forming of radii to give the desired rounded corners to the part. The most extensive of these steps are those which remove the metal between lugs, put radii between the lugs and bevel the sectors.

Breech rings then go to the assembly department where they are finished by hand and portable tools to remove all burrs and rough edges.

Breech blocks are cut from forged steel bars $5\frac{1}{16}$ x 6 in. in cross section and about 8 ft. long. These bars are set up on a Cincinnati planer and planed on four sides leaving 0.025 in. for grinding. They are then cut to 8.7 in. lengths in a Wagner cold saw. One end of the block is ground square with the plane surfaces by mounting it on an angle plate on the table of a Blanchard grinding machine.

The blocks are then put into a drill jig on an American radial drilling machine, to cut and counterbore a number of holes including the firing case hold and the load hole.

At this point the blocks are normalized by heating them to 1,500 F. for two hours and quenching them in oil. They are then reheated to 1,300 F. for two hours and cooled in the furnace. This normalizing process refines the grain and at the same time removes any strain resulting from forging or the rough machining operations.

The blocks go back to the Blanchard grinder to be finished on the sides and the ends. Then come two turret lathe set-ups. The first is on a Gisholt machine which does the finish boring of the firing case seat, the recess and the boring and reaming of a number of angular surfaces in this portion of the block. The second set-up is in a Libby turret lathe in which the recess is counterbored and threaded.

Excess stock which has been left on the muzzle face is then removed in a Cincinnati vertical machine leaving an allowance for grinding.

This face is then ground on a Norton surface grinder. In two set-ups on a Cincinnati horizontal milling machine, the load hole is rough and finish bored, first parallel to the firing case seat and then cut at an angle of 1 deg. 30 min. to give it the taper on one side as specified in this design.

The sectors in the firing case seat are then slotted in a Pratt & Whitney machine. After this the breech block is set up in an American radial drilling machine to drill and ream the $\frac{3}{8}$-in. vent hole, to drill the $\frac{5}{16}$-in. radius which forms the corner of the trigger arm clearance, to drill and ream the trigger shaft hole and the hole parallel to it and to counterbore the trigger shaft pocket.

Irregular Contours Formed by Profiling

A Gorton profiler is then used to form the recess clearance for the trigger. Another American drill set-up drills, counterbores and taps the 10-32 hole for the bushing lockscrew.

After the cover seat has been milled and undercut, by using end mills in a vertical milling machine, another set-up on a Gorton profiler is used to finish the trigger clearance.

The 1 deg. 15 min. angle on the breech face is then ground on a Blanchard surface grinder. A series of nine operations follow using vertical milling machines and profiling machines to mill a number of slots and seats in the block including the extractor cam slot. Following this the guide surfaces are ground on a Norton machine. Then the 1.825-in. bore at the muzzle end of the load hole is milled to a 51-deg. angle. It will be noted that this radius is taken in the

direction of the bore of the gun and not parallel to the direction of the cut.

This is done by setting up the block on the milling machine table parallel to the cutter arbor, but with the table itself swivelled to an angle of 51 deg. By using a milling cutter of the proper diameter, the work can be fed across at this angle, generating an eliptical surface that blends into the load hole opening. This work is done on a Kearny & Trecker milling machine. Two other set-ups using the same make of machine, mill the load hole clearances, both the right-angle clearance on one side and the 61-deg. angle clearance on the other.

A series of milling operations follow which have for their purpose the rounding of the various radii on the corners of the block and the many slots and recesses as called for in the design. Here again Gorton profilers and Cincinnati vertical milling machines are used.

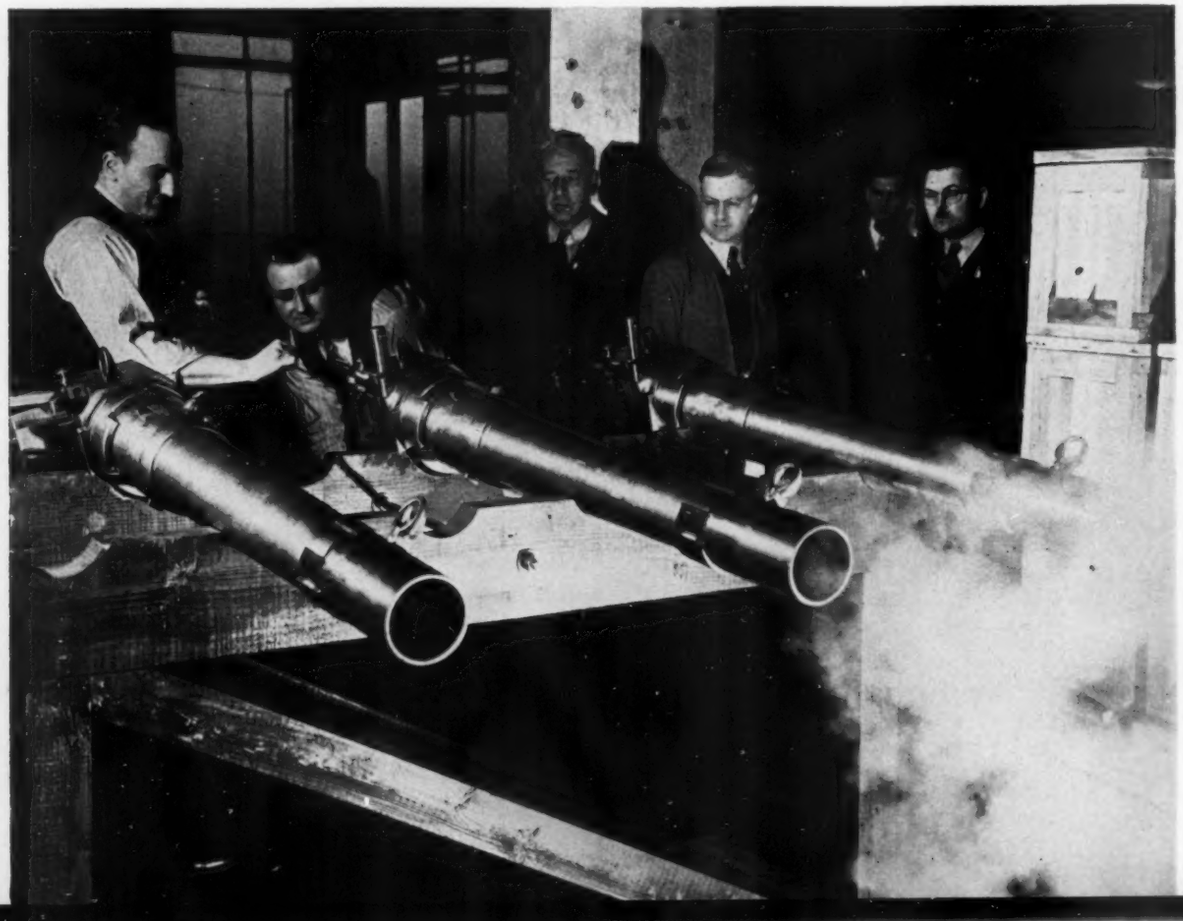
A block is then pack-hardened in a General Electric furnace and tested in the presence of a government inspector by means of a scleroscope. It is cleaned by mud blasting, reground on the outside surfaces in a Norton machine and hand-polished before assembly.

In addition to the main units described above, the breech mechanism of the 75-mm. howitzer includes a large number of small components which call for extreme accuracy in machining and assembly. All parts are carefully gone over by hand to burr and polish them in order that no surface roughness remains.

Each part is checked 100 per cent by Army inspectors before assembling. For this purpose a large number of inspection gages are used. A popular type of gage for this purpose is the flush pin gage by means of which a number of dimensions can be checked simultaneously when the part is seated in the fixture. The pins are pushed into contact with the work and if the dimensions are accurate, the outer end of each pin should come between two surfaces that form a step in the gage. These two surfaces represent the "go" and "not go" limits and are usually only a thousandth or two apart. In spite of the fineness of this measurement, it can be quickly determined whether the end of the pin extends above one surface and below the other. In this way rapid and precise checks may be made with a minimum possibility of error.

The Army inspector's booth is adjacent to the assembly floor. In addition to inspection of the parts themselves, they are scrutinized as they go together.

As a final test, three primers are fired in each assembled howitzer. These primers are inserted into the primer seat of empty shell cases and are then loaded into the breech just as if the gun were being used in service. Firing the primer gives an additional check on the functioning of the breech block. On removal from the gun, the primer is inspected in order to note the striking position of the firing pin.



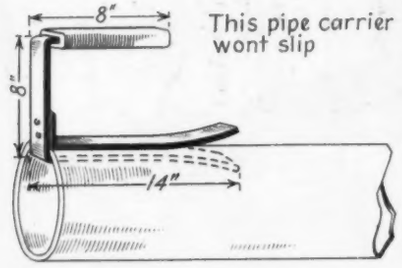
Howitzer components are carefully hand finished, fitted and assembled under the watchful eyes of the army inspectors

Small parts that make up the breech mechanism are carefully controlled as to size and quality by an exacting set of gages in the hands of an army inspector

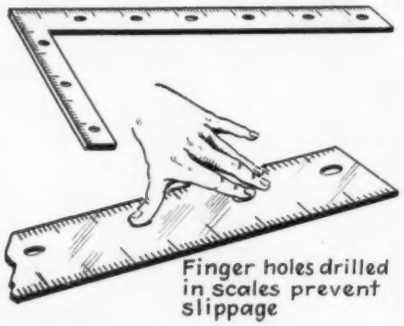
After assembly three primers are fired in each breech. The functioning of the mechanism and the location of the firing pin impression on the primer are noted

SHORT CUTS FOR THE SMALL SHOP

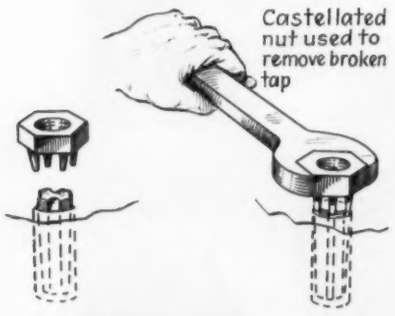
BY A. H. WAYCHOFF



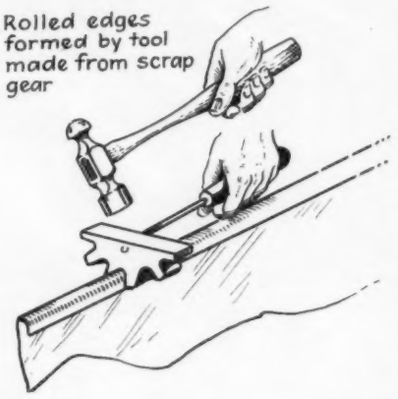
SIMPLE PIPE CARRIERS that will handle almost any size of pipe, won't slip out of position, and won't pinch the users hands can be made from ½-in. thick and ¾-in. wide steel bars bent and riveted together as shown. A short piece of rubber hose is driven over the handle to provide a comfortable grip. To use, the two tongues are slipped on the pipe.



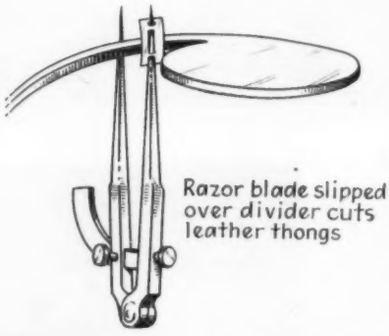
SCALES and SQUARES won't slip on polished surfaces, when used to scribe lines, if several holes are drilled along the middle of the blade and the thumb and forefinger are inserted in the holes to exert hold-down pressure. The holes should be ½ in. or ⅝ in. diameter so that the flesh will squeeze through the holes as well as against the sides of the scale. Space the holes for the best reach of the thumb and forefinger.



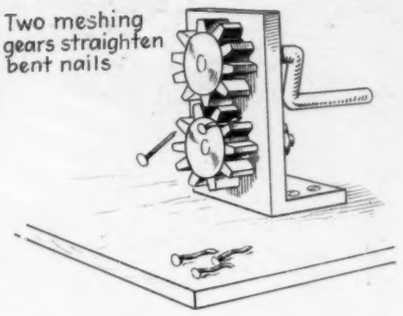
BROKEN TAPS can be removed with a steel castellated nut of the proper size from which all but four of the projections have been removed. The spacing of the projections should be that of the flute on the broken tap. After the projections have been filed down to slide easily into the flutes, the nut is inverted and placed over the broken tap, after which the latter can usually be removed without difficulty with the aid of an open end or monkey wrench.



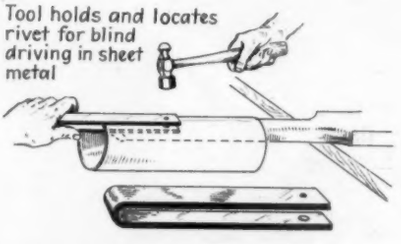
ROLLED EDGES on thin sheet-metal parts can be formed by taking a small gear, splitting it slightly above the shaft hole, and mounting on a handle. Light blows of a hammer during several passes of this tool along the edge of the sheet will form a rolled edge comparable with that of regular forming tools.



LEATHER THONGS can be cut from leather stock with the aid of a pair of dividers and a safety razor blade. The blade is slipped over one of the prongs of the dividers, effecting a slight curve of the blade, but which does not affect its use for cutting the leather. The other leg of the divider is spaced at whatever distance is dictated by the required width of the strip or thong. After the holding screw on the divider is tightened, the blade can be pulled easily through the leather, with the opposite leg acting as a guide to maintain accurately the width of the thong as cutting proceeds.



STRAIGHTENING NAILS or short steel rods can be done quickly by placing them between two meshing gears. Heavy coarse pitch gears are preferable. They are mounted on an angle iron, and operated with a crank set in the top gear. Space between the gear teeth can be adjusted by setting the shaft of the lower gear in a slot cut in the upright member of the angle iron. By such adjustment, pieces of different diameters can readily be accommodated. A shoulder bolt is used for the lower gear so that it can be slipped up or down in the slot, and tightened with the nut at any point desired, and still turn freely.



HOLDING RIVETS for driving in sheet metal is a problem when location of the rivet is inaccessible for the usual backing up tools. This work can be simplified with the aid of a U-shaped bar or strap of mild steel ½ in. wide, ¼ in. thick, and about 4 ft. long, in the lower leg of which a hole is drilled with a bottoming bit. This hole should be of such size and depth to take only the rivet head. A hole equal in diameter to that of the rivet is drilled in the upper leg of the tool at a position directly opposite the hole for locating the rivet head. These holes must line up perfectly. After the rivet is set in the cavity, it can be slipped along the work on the mandrel until it is located in proper position. For sheet metal not pre-drilled with rivet holes, this holder will afford sufficient support, so that a blow of the hammer on the rivet will force it through the metal. Obviously, the top hole in the upper leg of the tool will ascertain the location of the rivet for blind driving.

AMERICAN MACHINIST REFERENCE BOOK SHEET

Calculation of Bent Pipe Lengths

BY A. B. COX

THE FOLLOWING METHOD has proved usually convenient in calculating the length of straight pipe required for making bends. Dimensions of bent pipe are usually given between the ends of the pipe and between points of intersection of the pipe centerlines at the bends. Thus, in Fig. 1, the principal length dimensions are C, D and E. Occasionally, the length dimensions are given between the ends of the pipe and between center of curvature of the bends, in which case the principal length dimensions in Fig. 1 are X, Y and Z.

The length of the pipe before bending, commonly called total developed length, is

$$L = X + Y + Z + \text{arc } mn + \text{arc } rs \quad 1$$

if the second system of dimensioning mentioned above is used. All factors in this and following equations are in inches. Should the first system of dimensioning be used, the pipe length is

$$L = C + D + E - 2t + \text{arc } mn - 2u + \text{arc } rs \quad 2$$

The length of

$$\text{arc } mn = (2\pi\, Aa)/360 \quad 3$$

while the length of

$$\text{arc } rs = (2\pi\, Bb)/360 \quad 4$$

Equation (1) then becomes

$$L = X + Y + Z + A\frac{2\pi a}{360} + B\frac{2\pi b}{360} \quad 5$$

Values of the factors in parentheses for angles from 0 to 90 deg. are plotted as the dashed line in Fig. 2. For easy reference this factor is called f'. Hence, Equation (5) becomes

$$L = X + Y + Z + Af'_a + Bf'_b \quad 6$$

wherein the subscrips a and b denote the angle to which the factor f' belongs.

Another and probably more convenient method for calculating the length of pipe required can be derived from Equation (2). Referring again to Fig. 1, the length

$$t = A\tan(a/2) \quad 7$$

while the length

$$u = B\tan(b/2) \quad 8$$

Therefore, Equation (2) can be written

$$L = C + D + E - 2A\tan\frac{a}{2} + \frac{2\pi Aa}{360} - 2B\tan\frac{b}{2} + \frac{2\pi Bb}{360} \quad 9$$

or factoring out A and B

$$L = C + D + E - A\left(2\tan\frac{a}{2} - \frac{2\pi a}{360}\right) - B\left(2\tan\frac{b}{2} - \frac{2\pi b}{360}\right) \quad 10$$

Values of the factors in parentheses for angles from 0 to 90 deg. are plotted as the solid line in Fig. 2. This factor is called f. Hence, Equation (10) becomes

$$L = C + D + E - Af_a - Bf_b \quad 11$$

wherein the subscripts a and b denote the angle to which the factor belongs.

Values of the f factor can be put either in tabulated or curve form, and can be extended to cover a complete circle rather than the angles from 0 to 90 deg. as shown in Fig. 2. Tables of values for factor f' have long been used

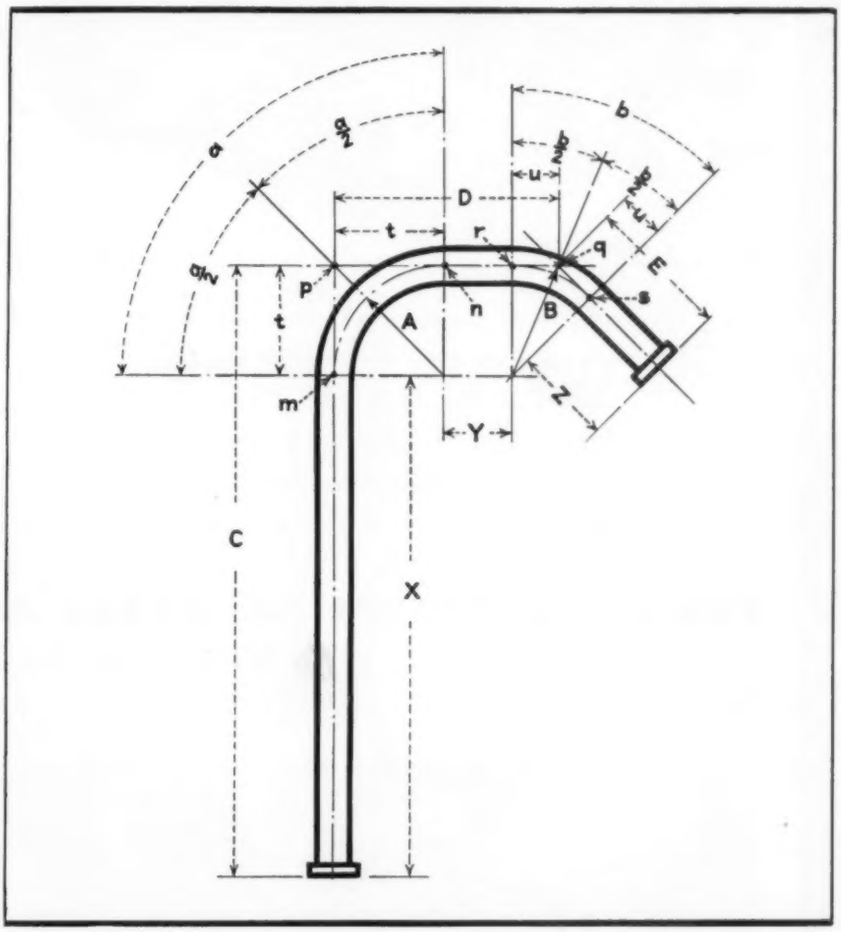
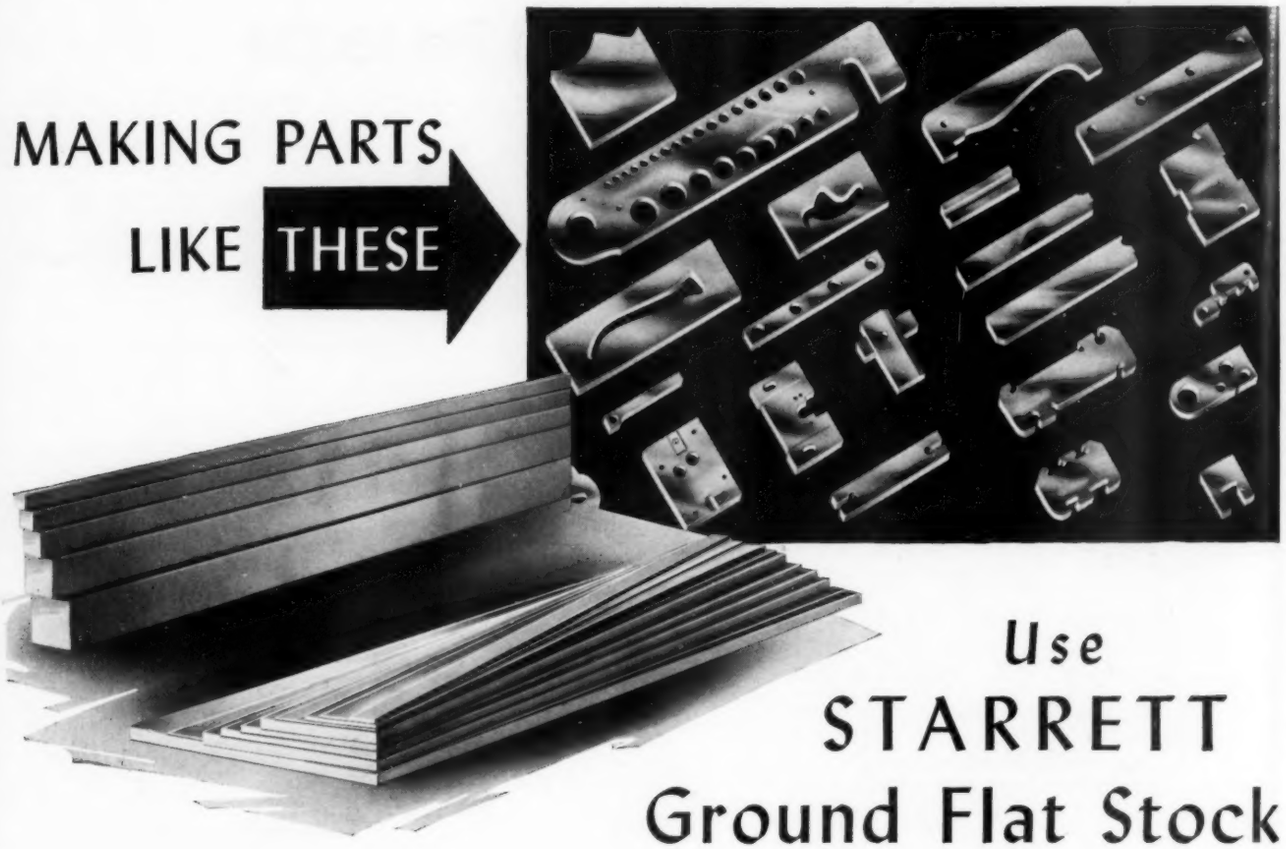


Fig. 1—Layout of pipe from which the straight length of pipe can be calculated for making the desired bends.

STARRETT GROUND FLAT STOCK

THIS IS NO TIME TO WASTE TIME

MAKING PARTS LIKE THESE



Use STARRETT Ground Flat Stock

Don't tie up men and machines grinding stock for small parts, tools, gages, etc. Keep a supply of Starrett No. 495 Ground Flat Stock in the crib. It comes in 18-inch lengths in a complete range of widths and thicknesses. Made of first quality tool steel, cut lengthwise from the sheet, ground to within .001" of size and annealed for easy machining. Each piece individually packaged and marked for quick identification. Write for special Ground Flat Stock Folder "C" and for a handy reference wall chart.

THE L. S. STARRETT CO., ATHOL, MASSACHUSETTS, U. S. A.

World's Greatest Toolmakers

Precision Tools . . . Dial Indicators . . . Ground Flat Stock . . . Hacksaws . . . Metal Cutting Bandsaws . . . Steel Tapes

Starrett GROUND FLAT STOCK

Calculation of Bent Pipe Lengths

but, as can be seen from the foregoing derivations, values of factor f are much more convenient to use.

Equation (11), involving the use of factor f, is quite accurate because the total correction in pipe length is relatively small as compared with that involved in Equation (6) using factor f'.

For example, calculate the length of pipe required for a bend in which $C =$ 4 ft. 6 in., $D = 1$ ft. $7\frac{1}{2}$ in., $E = 12$ in., $A = 10$ in., $B = 8$ in., $a = 90$ deg., and $b = 45$ deg. From Fig. 2, $f_a = 0.429$ and $f_b = 0.043$. Then, by Equation (11)

$L = 54 + 19.5 + 12 - (10 \times 0.429) - (8 \times 0.043) = 80.866$ in. say $80\frac{7}{8}$ in., or 6 ft. $8\frac{7}{8}$ in.

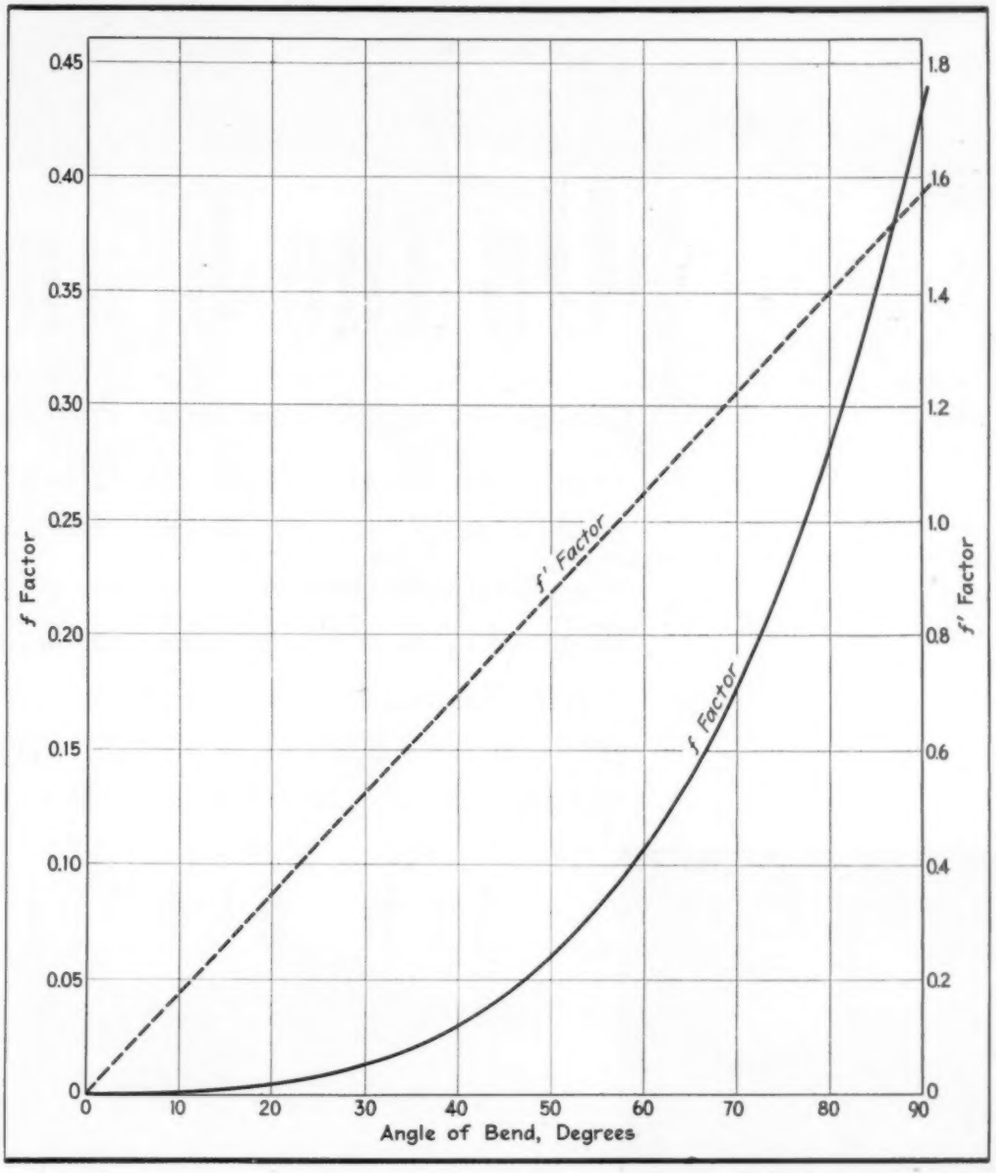
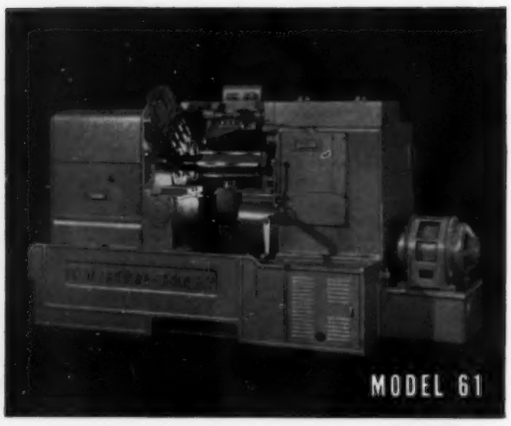


Fig. 2—These two factors can be used in calculating lengths of pipe bends. The author gives a convenient method of making the calculations using the f factor

On the beam...

Just as the radio beam keeps the plane on its course and brings it in on schedule; so do such machine tools as New Britain Automatics keep the Defense Program on its course, help bring it in on schedule. Fast, accurate, dependable, New Britain Automatics stay on the job. . . . . .
NEW BRITAIN - GRIDLEY MACHINE DIVISION, THE NEW BRITAIN MACHINE CO., NEW BRITAIN, CONN.



NEW BRITAIN *Automatics* STAY ON THE JOB

A complete line of Multiple Spindle Screw Machines up to 2¼" Capacity
Also a complete line of Chuckers . . . 4, 6 and 8 Spindles up to 10¼" Capacity

North of the Border

IN CASTING ABOUT for ways and means of accelerating the rearmament program, defense officials may find suggestions in the methods used to the north of us.

Canada differs from us in many respects. Her population, her industries and her financial resources are only a fraction of ours. In any one industry she has only a handful of producers and a relatively small number of consumers. Hence the controls which she so freely and successfully exercises may not apply so readily here.

But some of her ideas are worth considering. They may suggest a fresh approach to our own problem of utilizing our abundant industrial resources to full extent.

In contrast to the elaborate system of formal priorities which Washington is imposing increasingly upon U. S. industries, the Canadian method is simple and direct. In this country manufacturers have daily headaches over A-1-a's and A-1-c's and are lucky if they can straighten out the hieroglyphics to Washington's satisfaction as well as to their own. The Canadians don't bother with all that. A voluntary system prevails and works. The delivery date of materials or equipment is what counts. No priority ratings are put on contracts. They are not necessary if deliveries can be made at the desired time.

In the Canadian pulp and paper industry a scheme has been concocted which aids training of men for war factories and also puts to work in its idle hours on defense orders the machinery used on single shifts for non-defense purposes. Around thirty concerns have banded together and secured war contracts totaling $10,000,000 a year. Eight hours a day they operate their machine departments on maintenance work for their regular business. The other sixteen hours these departments are busy producing war materials.

These pulp and paper firms have taken on trainees and made semi-skilled machine operators out of them. They also have trained some skilled men. When a munitions plant is hard pushed for fifty operators, the pulp and paper people will supply the fifty, drawing only a few men out of any one shop. The plan is proving so practical and helpful that it is rapidly being extended to the mining, utilities and petroleum industries.

Just because a company has not done airplane work before is no reason for the Canadian government to deny it an airplane parts manufacturing contract. The complaint may be raised that the shop is not equipped to do such exacting jobs and cannot manufacture to the close tolerances required. Even that supposedly knockout point doesn't stop smart management from using ingenuity and licking the task. It has been found that engineers who are not steeped in the traditions already grown up of how to do a particular airplane job will devise new methods of manufacture superior to the old technique. And the new methods will make use of existing facilities.

These are only a few of the many ideas generated by a Canada at war which deserve our close study. It would be an error to toss them off as unworthy of examination merely because Canadian industry and American industry appear dissimilar.

The U. S.-Canadian rapprochement is not one-sided. Canada, of course, will gain much from it. But so will we. All that is necessary to convince one of that fact is to make a visit north of our border.

Burnham Finney

GAGING BUSINESS

OPM to issue list of projects to be favored by machine tool builders in making deliveries. Industry committee to be set up for machine tools. Tool builders to get new priorities

OPM will shortly send out a list of specific defense projects with their priority rating, indicating the projects within any one priority group, such as A-1-B, which are to be favored first with deliveries of equipment and materials. This action will aid machine-tool builders tremendously in determining what customer in a given classification is to secure tools ahead of another customer. Heretofore the only breakdown provided by Washington has been to put certain items, such as ships and planes and anti-aircraft guns, into general classifications (like A-1-C, for instance). Many people in the metal-working industry believe that subcontracting should be tried out more extensively than it has been before the Government resorts to such drastic measures as the "seizure" bill now before Congress, which permits the Government to take a critical machine out of one plant and put it in another where it may be needed for defense work. Unwittingly the Government, by such action, might completely cripple the plant from which the machine has been removed, thus causing considerable unemployment. Already protests are being made to OPM because unemployment in non-defense industries is growing rapidly due to the working of the priorities system.

Machine Tools—An industry committee for machine tools will soon be set up in OPM. The committee will be similar to committees in such industries as steel and automobiles and will include representatives of press builders and of machinery manufacturers whose products normally are not classified as machine tools. Both letters of intent and defense plant contracts are coming through to machine-tool builders in connection with the tool needs of the heavy bomber program, and the placing of orders, which will be close to half a billion dollars, is well on its way. The new ordnance manufacturing program, for which new congressional appropriations are expected shortly, is second in importance only to the bomber requirements in machine tools at the moment. Up to this time the ordnance production schedule has been delayed because higher priorities were given to materials and machine tools for ships and planes. Now ordnance gets its turn to secure what it must have. OPM is about to revise the priority ratings of machine-tool builders, some of them to have their A-1-A ratings reaffirmed and others to be granted A-1-C ratings. Heretofore all builders have been rated A-1-A. Few if any machine tools are believed on order for Russia in the machine-tool industry. So-called "token" shipments may be made of a few machines to indicate Washington's encouragement to Stalin to fight Hitler, but volume shipments are not looked for. Machine tool orders for Britain under the Lend-Lease program are being placed in larger amounts. The industry continues to produce at an all-time peak, with shipments running in excess of $60,000,000 a month. Many builders are worried about possible interruption to their supplies of steel and of other materials.

Railroad Equipment—As the Interstate Commerce Commission predicts a peak in carloadings of 1,000,000 a week by next fall, carriers are moving rapidly to add to their rolling stock. Almost 30,000 freight cars were ordered in June, a total larger than for any full year from 1931 to 1935. In the twelve months ended June 30, freight car buying exceeded any calendar year since 1924. Seaboard Air Line has ordered 500 box cars from Pullman-Standard. The Nickel Plate has bought 1,150 freight cars. Around 660 locomotives have been placed thus far this year. A serious shortage of steel is now being alleviated by a high priority rating granted car builders.

Steel—Some steel mills are reported advising big fabricators that all rolling schedules are now on priorities. Users with long-time mill connections look for growing trouble in getting shapes and plates for anything except contracts covering fairly high priorities. Steel mills are cooperating with Washington in expanding the industry's capacity, but they would like to have more specific information about the government's defense needs in various steel items. The industry is busy helping consumers find suitable substitutes for alloy steels which are scarce because of huge defense demands. The chances of the non-defense user getting steel have narrowed perceptibly the last two weeks.

Aircraft—Largest aircraft orders in history were awarded by the War Department the past week, the total exceeding $887,000,000. Glenn L. Martin received a contract for $166,261,526 for two-engined bombers to be assembled at Omaha, Neb. North American Aviation got an order for $127,440,000 to produce bombers at Kansas City. Chevrolet will furnish engines and spare parts amounting to $89,075,000. North American likewise will supply bombers worth $57,725,572 from its Dallas, Tex., factory. Other participants in the business were Vultee, $31,619,280; Northrup, $16,287,134; Bell, $15,885,081; Republic, $8,165,400; Douglas, $7,843,010; and Lockheed, $2,797,947. Though disappointment has been expressed over the failure of plane production to increase lately, actually the government's timetable is being met. Output the first half of 1941 was more than that in all of last year. It is expected that this year total assemblies will be 18,000 planes. About half of current production consists of combat ships.

Shipbuilding—Cargo ships and emergency ships for Britain are now being delivered at a rate of almost two a week. By November the schedule will be increased to four or five a week. Speed of ship construction has already passed the 1917-1918 level. Blanket priorities are being given the Maritime Commission to add more speed. A maximum of four months on the ways is being allowed the emergency ("ugly duckling") ships, plus three months in wet basin. The Commission anticipates that it can trim this schedule to three months on the ways, plus one and a half or two months afloat, or a total of four and a half to five months from keel to delivery. If that is accomplished, the 1941 building program will be approaching double the speed of 1918. The Maritime Commission has called for bids on two new types of harbor tugs and on a new small cargo vessel called a "coaster." The latter, a small freight ship will be able to pass through the Welland Canal between Lake Erie and Lake Ontario. With the end of the Pacific Coast Machinists' strike last week work will be speeded again on the $500,000,000 in contracts for ships which includes 29 U. S. naval vessels.

Munitions—Tremendous expansion of ordnance manufacturing capacity is assured by a new program launched at Washington. A new string of ordnance factories will be built and ready for operation by the end of the year. Cost will be over $300,000,000. In addition the War Department has authorized expansion of plants already in production or nearing completion, some $185,000,000 being set aside for that purpose. Federal Cartridge, Remington and U. S. Rubber will each operate a small arms ammunition plant at St. Paul, Salt Lake City and Des Moines respectively. Hercules will run a $16,750,000 ammonia plant at Louisiana, Mo., and a $39,000,000 TNT plant at Chattanooga. Johns-Manville will manage a $35,000,000 shell loading plant at Parsons, Kan., and Silas Mason, Inc., a similar plant near Minden, La. Johnson & Johnson have been selected to operate a bag-loading factory near Terre Haute, Ind. An ammunition loading plant will be built at Jacksonville, Ark. and a shell-loading plant at Texarkana, Tex.

OPM Formulates Plans to Expand Aluminum, Magnesium, and Steel in New Defense Move

WASHINGTON—Broad plans for expansion of raw materials output—aluminum, magnesium, steel—were formulated by OPM last fortnight. Most far-reaching moves were aimed at raising aluminum output, now nearing 800,000,000 pounds a year, to a total of 1,400,000,000 by the Spring of next year. This would be supplemented by Canadian imports of 200,000,000 lbs. a year.

The OPM program is based on studies of available power made by the Federal Power Commission and OPM's power expert, J. A. Krug of TVA. The major problem in aluminum capacity, of course, is finding sources of power. Eight new plants are to be built by the Defense Plant Corp. and operated by private firms. What firms would run the plant has not yet been announced, but it is expected to include Alcoa, Reynolds, and Bohn Aluminum.

Eight New Aluminum Plants

One 100,000,000-pound plant would be built in Arkansas; two, with a total capacity of 140,000,000 in the Columbia Valley; two, totalling 150,000,000 pounds in upper New York State; a 100,000,000-pound plant in Alabama; a 70,000,000-pound plant in California; and a 40,000,000-pound plant in North Carolina. Meanwhile, it is suggested that within a few months this program may be stepped up by an additional 200,000,000 pounds annually.

Recently a special Senate committee investigating the defense program reported that an aluminum shortage of at least 300,000,000 lbs. a year was threatening to curtail aircraft production by 25 per cent in 1942. Senator Mead (N. Y. Dem.) in reading the report of the committee indicated that inaccurate estimates were responsible for the situation.

"The Office of Production Management," he said "admitted that it would need 100,000,000 lbs. of aluminum a month after February for the defense program alone. The maximum that could be produced by that time under present plants was 75,000,000 lbs. per month." The report notes that the OPM has called for 600,000,000 lbs. a year additional to meet civilian requirements plus the 1,200,000,000 lbs. for defense. This is above the capacity production of all plants operating, or being built or in the blueprint stage.

Few details are yet known of the OPM's plan to step up magnesium production by an even greater percentage. Output of this light metal, essential to aircraft production is now running at about 30,000,000 pounds a year. Plants now scheduled will raise this to 75,000,000. OPM proposes to reach a production of 400,000,000 pounds a year by late 1942. Some seven companies are involved in the program; it is believed that at least one element will be a new plant in the Columbia Valley to be built by the Kaiser interests, which are just entering the magnesium industry with a new plant in California.

Following out its plan to step up steel capacity by 10,000,000 tons a year, OPM has approved a plan for a 400,000-ton increase in ingot output and is considering steel company proposals for 1,556,000 tons, all accompanied by corresponding increases in finishing capacity. The approved project will involve expansion by Carnegie-Illinois of its ingot capacity and its output of armor, special steels and heavy forgings at the Homestead and Duquesne, Pa., plants. It will cost $85,000,000.

Largest of the proposed projects, which are all on the West Coast, is that submitted by the Columbia Steel Co. This $63,200,000 program would include ingot capacity of 930,000 tons. Bethlehem proposes a $12,000,000 expansion, increasing ingot output by 276,000 tons. Smaller expansions are planned by Pacific State Steel, Pacific Car and Foundry, and Colorado Fuel and Iron. Nearly all of this new steel capacity will be government-financed.

U. S. Survey to Determine Why Efficiency Varies

WASHINGTON—A new government survey designed to learn why some industries are more efficient than others and to pool ideas to assist the slow ones, has been instituted as a direct result of a continued serious lag in the production rate of some industries manufacturing defense items. The government organizations making the survey are unnamed at present and preliminary findings have not been made public.

Although strikes have been one of the serious problems in defense production and have monopolized public attention, other problems exist. In an industry already studied, it was found that companies operating on the same basis on similar contracts produced an output of about one-fifth to four-fifths of theoretical capacity.

One of the problems they will then be able to attack, they contend, is that of the industry which is deliberately stringing out its production on government orders so as to keep its operations relatively level. This, of course, saves investment of additional capital and is desirable under normal circumstances, but not in a period of emergency.

More Aluminum—*As a part of Aluminum Company of America's self-financed $200,000,000 expansion program, the new extrusion mill (above) at the Vernon works, Los Angeles, will soon reach a capacity of more than a million pounds of extruded shapes a month. Completed early in 1938, the plant had a capacity of 100,000 lbs. of aluminum alloy forgings at the start of the war in 1939. Shortly, the forging capacity will have been expanded to 450,000 lbs. a month, an increase of 350 per cent. The company is also expanding its Lafayette, Ind. works which produced 695,000 lbs. of extruded shapes in 1939, now it's producing 4,256,000 monthly, or six times that capacity*

Canada Producing Munitions on Mass Basis Without Using System of Formal Priorities

OTTAWA—Canada is over the hump in tooling up many of its munitions plants and now is in volume production. This has been accomplished without resort to a system of formal priorities, such as exists in the U. S. for machine tools, aluminum and other commodities.

Those in charge of securing materials and equipment for Canadian war industries believe that voluntary priorities are more flexible than a formal plan and do not result in cluttering up manufacturers' operations with unnecessary paper work. Responsibility rests on suppliers to see that delivery dates are met, but orders are not assigned priority ratings. The only place where the Canadian government has run into priorities of a strictly formal nature has been in securing materials and equipment from the U. S.

Co-ordinate Training, Idle Machines

The training of semi-skilled workers and full utilization of idle machines for war production have been neatly tied in together. Certain non-war industries, such as the pulp and paper industry, have realized that they would be called upon to supply skilled men to war plants (or would lose them any way on the basis of higher pay). In the pulp and paper industry, machine shops are normally operated 8 hrs. a day for maintenance purposes. The industry banded its members together and got itself war contracts, the result being that about 30 shops are working 8 hrs. a day on maintenance jobs and 16 hrs. a day on defense orders, which run around $10,000,000 a year.

The pulp and paper companies have brought in trainees who, after they have become skilled, are loaned to plants working exclusively on war contracts. If a war concern wants 60 tool makers, for example, the pulp and paper firms supply them by taking a few away from each shop. This way of subcontracting and of training men is being extended to the mining, utilities and petroleum industries. In this way it is believed that the machine hours worked on defense jobs in Canada will be doubled.

In Canada the 48-hr. week is standard, with time-and-a-half for overtime. The average factory is working 55-hr.-a-week shifts. The government has not encouraged working much longer hours than that. Fifty per cent or more of war factory workers are under 27 years of age. The government will furnish war industries this year some 50,000 men trained in schools operated jointly by the federal government and the provinces. War plants themselves will train another 50,000.

Trainees with families are given $12 a week during their training period. That plan brings in the older men. In fact, young men will not be taken for training unless military authorities say it is all right. Until recently little trouble has been experienced getting trainees, but lately older age groups have been more numerous and a slackening has occurred in the number of trainees from the central provinces. The government schools cost around $6,000,000 a year. The provinces provide the schools and equipment and pay a portion of the instructors' salaries, but the main burden of expense falls on the federal government.

Strikes and manhours lost by work stoppages are down considerably in Canada from 1940. Restlessness in U. S. organized labor, however, has spread to Canada and government officials are uneasy about the trend. Means of halting labor from interfering with war production are being worked out.

Up to this time no order has been issued by the government restricting non-ferrous metals use for civilian purposes. The government has relied solely on cooperation. It first called on aluminum producers to help, and then upon consumers. Consumption for non-war goods was reduced from 1,000 tons of aluminum a month to 25-50 tons. This system was possible because of the limited number of producers and consumers. The amount of aluminum offered to Canada from the U. S., at least until recently, makes Canadians wonder whether the U. S. controls over use of that material are as real as reported.

Steel Capacity Increased

Under a civilian controller, the Canadian steel industry is enlarging its capacity from 1,990,000 tons at the end of 1940 to 3,000,000 tons by 1942. Capacity now is 2,250,000 tons. The industry has been put on the honor system in rationing steel to defense industries; and the system has worked well. Alloy steels are in tremendous demand. All steel needs this year will total 3,100,000 tons. At first no steel expansion project was started which could not be finished by the end of 1941. That restriction has been removed; no time limit exists today.

Instead of beginning brand new steel plants, the policy has been to add to existing mills. One alloy steel plant has been increased five times. Output has been stepped up by such action as adding heating capacity to rolling capacity, thus rounding out facilities better. Sheet steel is a tight spot. Other material is being substituted for use in culverts and for containers for lard. It begins now to look like pretty rigid regimentation of certain steel items will be necessary. Pig iron cannot be bought today without an order from the steel controller's office.

MAY SEIZE MACHINERY

WASHINGTON — Civilian industries whose activity is reduced by defense competition for materials are likely to find tools snatched out of their plants. Long range objective of the administration is to bring the job to the machine, convert idle civil facilities to military production. For the short run emergency machines will be put in plants which need them and already making munitions. OPM Director Knudsen last month released a letter from the President in which Roosevelt emphasized that although "in the long run . . . subcontracting and a wider use of consumer goods manufacturers . . . will greatly increase production," it is necessary that "defense industries tries secure needed machine tools." Legal machinery to carry this out will be available in the pending "draft property" bill, which has now been rewritten to aim it specifically at tools, inventories, and patents. Meanwhile, OPM, as pointed out in our last issue, is getting ready for quick action by its census of critical tools.

Time Lost by Strikes Decreases in Canada

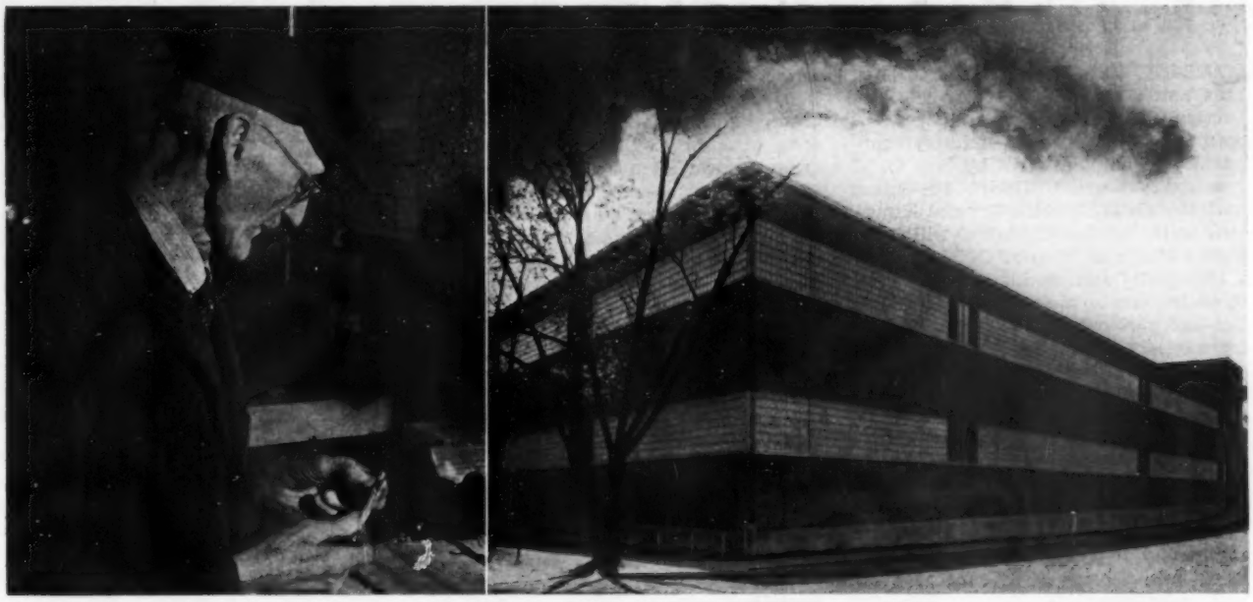
MONTREAL—Time lost due to strikes in war industries was down 44 per cent, 22 per cent in non-war industries, during the first five months of 1941. Lately, however, an increased number of wage disputes has been referred to conciliation boards and organizing activity has been on the increase in many plants. Recently the government has ruled that all conciliation boards must submit their reports to the Minister of Labor for approval. The freezing of all wages at present levels is under consideration.

National Steel Car Corp. is doubling productive capacity at its Malton, Ont. plant as a result of a contract award of $25,000,000 for Martin B-26 bombers. Engines, propellers, and instruments will be imported from the U. S. The corporation's Hamilton plant, taken over by the government a few months ago, continues in shell production.

Hamilton Steel Car has switched from production of trainers to bombers. Canadian Car & Foundry Co., Ltd., Montreal, will make four-engined 12-ton Consolidated bombers at its Fort William, Ont. plant; the plant has been making Hurricanes and will continue until the re-tooling job is completed.

The Munitions and Supply Department has recently let the following contracts: Aircraft: Aviation Electric Ltd., Montreal, $201,426; Canadian Vickers, Ltd., Montreal, $197,454; Canadian Wright Ltd., Montreal, $262,440; National Steel Car Corp., Ltd., Montreal, $27,500,000.

Greenfield Tap & Die Corp. Increases Gage Production Speed at New Plant



GREENFIELD, MASS.—When the Greenfield Tap & Die Corp. began increasing its productive facilities last November it planned to quadruple gage production, assure a closer accuracy control despite plans for greatly increased quantity and speed of production. By mid-April equipment was moved into the new 200 ft. by 80 ft. two-story building (upper right) which provides for a third story when necessary. May 30 the plant was dedicated. General C. M. Barnes, assistant chief, Industrial Service, Office of the Chief of Ordnance; and General Stewart, commanding officer, Springfield Arsenal, were among the prominent government and industrial leaders who attended the exercises. During the ceremony Harry Kellogg, (upper left) more than an octogenarian and a veteran employee of the company, presented the first gages made in the new plant to General Barnes. By strange coincidence Kellogg was the man who made the first commercial gage turned out by Greenfield 31 years ago. Since the new plant has been in operation, —less than a month—preliminary figures indicate a substantial reduction of the time gages are in process and a tremendous increase in the amount of production. In no small way this is due to a new air-conditioning system installed in the plant. Artificial ventilation, elimination of atmospheric and manufacturing dust, and stabilization of temperature is maintained day and night. Even from season to season the change will be extremely slight. One system controls temperature and humidity; it is completely automatic. This makes a closer control of finishing operations, enables more speed and accuracy. Too, hundreds of thousands of dollars of new machinery has been procured to add to speed and production accuracy.

Ford Labor Agreement Most Liberal Ever Made; UAW May Ask Other Firms to Fall in Line

DETROIT—UAW union observers indicate that the whole automobile industry will be on a union shop basis within a year, and the check-off system of union dues will be a common practice. This is a direct result of the agreement of the Ford Motor Co. to the most advanced labor contract in the industry. The new Ford contract, first labor agreement that the company has made in its 38-year history, is as drastic and departs as abruptly from precedent as did Ford's announcement of a minimum wage of $5 a day, 27 years ago. This experiment by Ford may have as far-reaching results throughout American industry as came from the company's 1914 move. Further, its provisions constitute an abrupt about-face for the company, which had been the only holdout against unionization of automobile workers in recent years.

The check-off of union dues, which Ford granted, hadn't heretofore ever been demanded by the union from any company. Responsible automobile officials, who naturally aren't commenting publicly on the Ford agreement, are privately much concerned for they fear that the UAW-CIO immediately will make demands upon them for the same thing. Although many auto companies have labor contracts which run for many months, experience has proven that the union never has been backward about going after advantages. Recently the union had moved to change contract provisions which still had several months to run at Chrysler, Briggs, Gar Wood Industries, and Bohn Aluminum, and compelled these concerns to raise wages.

On the bright side of the Ford ledger is a very important and tangible concession from the contracts: the company will have the right to place the union label on its cars. In some sections of the country Ford sales have been seriously affected by a virtual boycott by union labor in retaliation of the company's heretofore anti-union attitude. Now that Ford has gone all the way in giving the workers what they ask, the advantage will lie with the Ford Co. Even the principal competitors admit this.

AUSTRALIA BANS STRIKES

CANBERRA, AUSTRALIA — Strikes and lockouts in war industries have been forbidden here and the government has the right to seize plants and factories where such occurrences would slow down production. The munitions industry is still handicapped by a shortage of machine tools and skilled labor. More men and plants will have to be transferred from civil industry to war work. The government is instituting a new authority empowered to survey civil production, to requisition factories and plans for war work in order to concentrate civil industry on a limited number of essentials.

TODD YARDS EXPAND

NEW YORK—The Todd Shipyards Corp. will further expand its shipbuilding and repair plants at the request of the Maritime Commission and Navy in order to accelerate the U. S. merchant ship program.

Set-up 30 Industry Committees Within OPM: Roosevelt May Reorganize Priorities System

WASHINGTON—In an effort to save time and personnel the Office of Production Management has adopted a plan to set up about 30 industry committees, each matched by an OPM commodity section. Under the plan, indicates OPM Director General Knudsen, each major industry will deal with a single division of OPM through a commodity section, instead of having to go in turn to the production, priorities and purchases division. The industry advisory committees, which will be selected by OPM from lists of nominees provided by each industry, will enable an expeditious discussion of a particular industry's problems.

The move attains two objectives: (1) a close and unified working relationship between members of the several divisions concerned with the same commodity or material; and (2) efficient liaison between defense agencies and industries.

The commodity sections will study all problems within their scope that may arise and make recommendations, but final decisions will be made by the division head in charge of each section. Responsibility for over-all coordination in the several fields of production, priorities and purchases, will also rest with the division heads.

Knudsen indicated that he did not think the new set-up would duplicate Leon Henderson's office of Price Administration and Civilian Supply.

Talk About Changes in Priorities

Meanwhile, in addition to the reorganization of OPM, there is much talk that President Roosevelt is about to set up a new priorities system. The main purpose will be to eliminate overlapping of functions between government agencies. The government will use the device to channel materials and machines away from civilian production into direct and indirect defense work.

It is thought that the president's new executive orders will indicate that the business men in OPM will dominate the new priorities policy. Although at present two agencies, OPM and OPACS, have priorities jurisdiction, OPM over defense work and OPACS over civilian supplies, it will be qualified by the new orders to the benefit of OPM. OPM will be given authority over all direct and indirect defense production, and will have authority to decide what direct and indirect defense matters are. Hence, OPM will have the authority to decide any jurisdictional dispute between itself and OPACS. After OPM has determined the defense requirements in materials like steel, copper, machine tools, etc., it will then, under the new executive orders, tell OPACS what these requirements are, so that the latter can know what is left for civilian consumption.

No abrupt change is forecast in operation, however, but certain lines of gradual shifting are mentioned by persons working on priorities. Of these general lines the most important is the transition to "blanket" control running horizontally through an industry.

The priorities system which started out as piecemeal production system, scheduling item-by-item and culminating in a "critical list" of materials and equipment, is being replaced by horizontal controls of two kinds: (1) an industry, like shipyards, is assigned a blanket priority rating which it might place on all orders for supplies and equipment for defense work; (2) an industry like aluminum, producing an item in which there is an extreme shortage is placed under an allocation system and may fill orders only as OPM permits.

OPM has set up only a few of these horizontal priorities thus far, but the list is expected to grow. The second type of horizontal control, aimed at allocating supplies, covers aluminum, magnesium, nickel, nickel-bearing steel, ferro-tungsten, machine tools, synthetic rubber, copper, zinc, etc. Producers of these materials are given a general formula which covers the disposition of their output. Usually OPM goes over the producers unfilled orders, telling the producer when and to what extent he shall fill the orders on his books.

SEE PLANE PRODUCTION FALL

WASHINGTON — Production of military aircraft for the U. S. and Britain is retarded, will stay that way through July and August, primarily because of shortages of essential materials. Among reasons given was the fact that various new metals recently were turned out, and these had to undergo tests and have various weaknesses remedied before quantity production could be started. But the principal cause of slump was a shortage of aluminum, magnesium, and to some extent machine tools. A substantial increase in plane output is scheduled for probably in October.

Exports of Industrial Machinery Continue High

WASHINGTON—U. S. exports of industrial machinery in April, were valued at $40,963,265, showing practically no change from the March figure of $40,418,406, it was indicated by the U. S. Department of Commerce. Almost all of the major export groups remained fairly steady with the exception of textile, sewing and shoe machinery, which increased 38 per cent over the March total.

April exports of machine tools, totalling $19,021,589 was slightly larger than the March shipment which totaled $17,947,326.

Exports of Machinery During April, 1941

	April 1941	March 1941	April 1940
Electrical machinery and apparatus	$12,277,718	$11,558,112	$9,678,933
Power-generating machinery, except electric and automotive	2,950,445	3,173,673	3,231,576
Construction and conveying machinery	2,772,473	2,944,385	2,971,730
Mining well and pumping machinery	3,557,340	3,941,353	4,543,430
Power-driven metal-working machinery	20,362,900	20,032,856	21,281,332
Other metal-working machinery	2,018,432	1,906,059	850,298

Metal-Working Machinery

Engine lathes	1,190,866	1,200,744	1,464,428
Turret lathes	1,354,004	2,534,895	1,661,933
Other lathes	958,885	2,982	697,389
Vertical boring mills and chucking machines	661,801	639,585	843,652
Thread-cutting and automatic screw machines	1,940,239	1,426,085	2,078,130
Knee and column type milling machines	2,891,862	1,998,082	812,514
Other milling machines	2,393,322	1,918,919	1,361,209
Gear-cutting machines	457,278	422,501	678,213
Vertical drilling machines	408,963	495,652	632,724
Radial drilling machines	143,171	219,349	246,526
Other drilling machines	560,759	588,639	521,729
Planers and shapers	325,160	769,666	430,766
Surface grinding machines	515,688	452,148	519,932
External cylindrical grinding machines	461,891	769,511	813,712
Internal grinding machines	378,691	402,050	946,807
Tool grinding, cutter grinding, and universal grinding machines	581,351	604,957	502,455
Other metal-grinding machines and parts	690,319	476,284	1,090,954
Sheet and plate metal-working machines and parts	1,429,735	1,515,120	1,020,457
Forging machinery and parts	902,601	1,446,715	650,517
Rolling-mill machinery and parts	208,001	345,825	1,867,793
Molding machines	48,904	19,099	52,695
Other foundry equipment and parts	340,294	259,626	82,298
Other power-driven metal-working machinery and parts	1,705,062	1,513,889	2,285,388
Pneumatic portable tools	138,655	168,041	386,674
Other portable and hand or foot-operated metal-working machines and parts	278,001	226,620	140,350
Chucks for machine tools	107,052	63,028	29,636
Milling cutters, machine-operated threading dies and taps, and similar machine-operated metal cutting tools	891,547	726,552	98,123
Other metal-working machine tools and parts	603,177	721,818	195,515

INSIDE DETROIT

Since Knudsen outlined his bomber program only eight months ago the auto industry has done much toward production. Seven companies building aircraft engines; subassembly program well under way

BY RUPERT LE GRAND, DETROIT EDITOR

DETROIT—So much has been said about the automobile industry's participation in the bomber and aircraft engine production programs that the public may wonder what is going on and how soon results can be expected. Why not bombers and airplane assemblies and engines now?

Only eight months has passed since Knudsen outlined his bomber subassembly program to automotive brass hats. That is a relatively short time for tooling up a completely new program of the dimensions proposed. And one should remember that the program is planned and dictated by Washington. As lessons are learned from the war, as the lend-lease requirements change and as defense needs unfold, new situations arise. But now that the procurement method is established and contractual relations between industry and the government set up, things are happening.

Contracts on Cost Plus Fee Basis

Most of the aircraft contracts are on a cost plus eight per cent fee basis, which means that after taxes the manufacturer will make about two per cent net profit. Nevertheless, this form of contract has the elasticity to make rapid changes in plans, especially when it becomes essential to put construction and tooling work on a 24-hour, seven-day-week basis.

Though automobile people are free to cut whatever corners they can in getting into aircraft production, they are subject to the master plan of the War Department. That plan is supervised by the Central Air Corps Procurement District with headquarters in Detroit. This district office has the job of coordinating deliveries of equipment to aircraft plants and of saying which projects should get preferred treatment. The district's army of inspectors, liaison men, production men and auditors will not attain a peak for a year.

As originally conceived, the plan was for large motor car makers to handle major subassemblies and complete assemblies of aircraft, the responsibility for final bomber assemblies to be retained by aviation companies. Final assembly would be in new government-owned plants to be built in the interior of the country. Thus Ford would produce subassemblies for the Consolidated four-engine bomber, ship to assembly plants at Fort Worth and Tulsa, where Consolidated and Douglas would take over.

But Ford has prevailed in his wish to produce complete bombers as well as subassemblies. The program has passed through three stages, each time getting larger until on June 26 it was announced that Ford would proceed with construction of a $47,000,000 plant to build 75 complete bombers a month and likewise to furnish parts and subassemblies for 100 bombers to the Fort Worth and Tulsa plants. Actually, Ford will be able to assemble at least 150 complete bombers a month on a two-shift basis and may easily supply 130 bombers a month in knocked-down form.

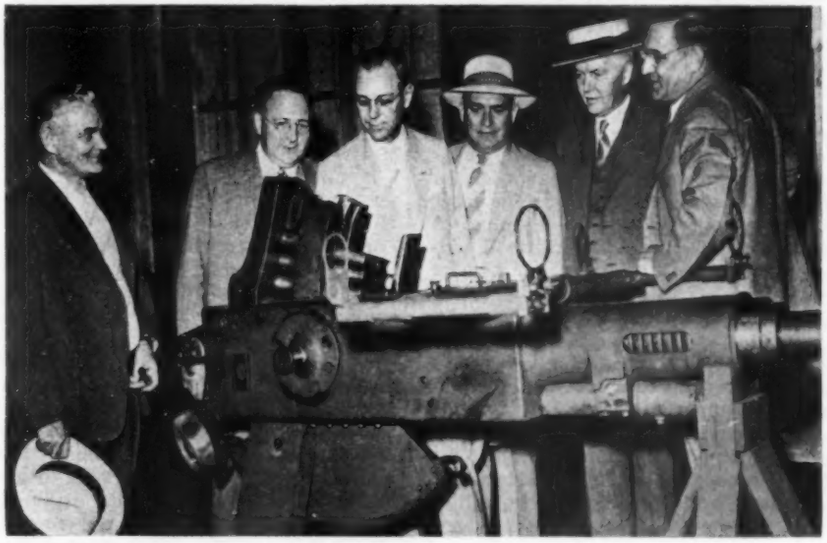
The Ford bomber plant at Willow Run will be of gargantuan proportions. Ready by next February, it will house huge framing fixtures, which are customarily located outdoors at West Coast factories. By Summer, 1942, at least 40,000 men will be working at Willow Run. Ford now has orders for 2,000 bombers, of which 800 are to be assembled at a cost of $240,000,000 and the remaining 1,200 will be furnished in knocked-down form for a like amount. More than 200 Ford engineers are making production studies for the bomber program.

Fisher Body will produce $62,000,000 of subassemblies for North American model B-25C two-engined bombers to be assembled by the latter at a new $10,000,000 plant at Kansas City. This bomber recently passed its acceptance test. Fisher will begin parts manufacture in August, reach top operations in December. It will make in its Memphis and four Michigan plants the complete empennage or tail assembly, other control surfaces (flaps and ailerons), wing panels, fuselage panels and nacelle structures. These components represent 40-50 per cent of the work in building the airframe and will be shipped to Kansas City for fitting to the center-wing section, the principal subassembly to be fabricated there. Parts not supplied by Fisher will come from North American's Inglewood, Calif., and Dallas plants. Operations at the Inglewood plant will be duplicated by Fisher.

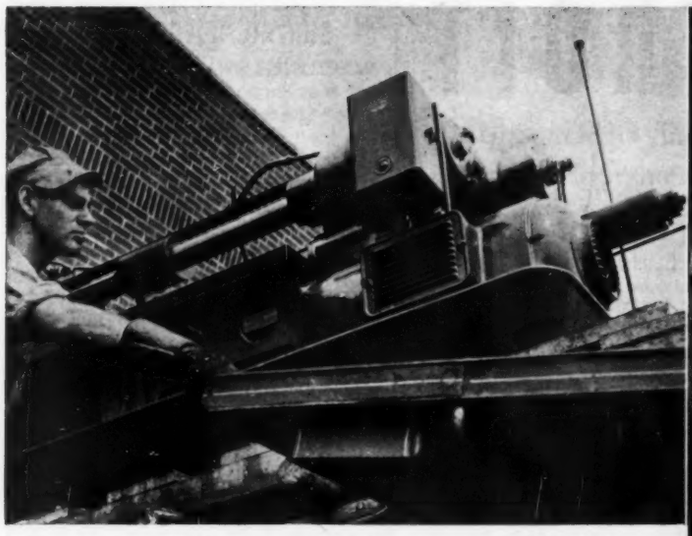
Subassemblies for the Martin two-engined bombers were split among three companies. Chrysler will make the nose

CURTAIL AUTOS AGAIN

WASHINGTON—The auto industry may be called upon to produce three times its present $2,000,000,000 load of defense contracts next year, indicated OPM Director Knudsen last week at a meeting of the industry's leaders called to form a defense advisory committee. The 20 per cent cut of auto production already decided for next year and which was to have reduced the number of cars by 1,000,000 must be increased as a need for accumulating larger stock piles of critical materials now exists. The new committee will discuss with OPM how much of a curtailment should be made.



S. J. Morriscttc, (left to right) operating manager, Chrysler Gun Arsenal; A. H. Patterson, and D. S. Eddins, vice-president and president, Plymouth Div.; S. J. Lamborn and W. J. O'Neil, vice-president and president, Dodge Div.; and Herman R. Weckler, vice-president and general manager, Chrysler Corp., examine the first pilot model of the Bofors 40-mm. rapid fire anti-aircraft gun to be made by the Chrysler Corp. in nine plants



When Walter Kidde & Co., Inc., began to move to their new plant at Belleville, N. J. they did it in a hurry. The moving crew picked up the machinery, loaded it on a truck (above) and in a few hours it was bolted in place (at right) at the new plant and work was continued

and center-section fuselage, Hudson the rear fuselage section, and Goodyear the wings and landing gear. The subassemblies will be shipped to a new plant at Omaha to be operated by Martin. The Martin program has not made the same progress as the others. Before all the drawings for the Martin B-26 reached Chrysler and Hudson, a switch was made to the B-26B, a later model. So far only a portion of the drawings for the new ship have arrived, but tooling up is proceeding as rapidly as possible. Jigs and fixtures should be installed by fall and production should be going by the year-end. This program has as its goal 100 bombers a month.

Chrysler's Bomber Parts

Chrysler will make bomber parts at the old Graham-Paige factory and at its Jefferson plant (where Bofors anti-aircraft gun parts are being built) De Soto is erecting a plant addition for both gun and bomber parts. The forge plant is being enlarged for aluminum forging production. Chrysler will employ 5,000 to 10,000 men on bomber parts.

Last year Douglas placed subcontracts with Murray Body for inner-wing sections and with Briggs for outer-wing sections for the model A-20A two-engined bomber. Because of military expediency, Douglas is introducing a over-lapping production program for a more powerfully engined model. This program is in the production planning and tooling phase, though so far as is known, no contract or letter of intent has been received.

The procurement program for air-cooled engines was not clarified until late last Fall. Normally it takes a year to get into production for a new airplane motor. Why so long? Because only 2½ per cent of existing automotive equipment is suitable for airplane work and practically all new machinery must be secured. Two months are necessary to lay out an engine plant and select machinery. Two more months are needed to design the building. Meanwhile machinery, tools, jigs and fixtures are ordered. They begin to arrive before the plant is completed, five or six months after its design is approved. With machinery installed, two months or longer is necessary to train workers and make a dent in production. At least a year passes before the plant is on its way, and three or four months longer before maximum output is attained. It is essential to find subcontractors and to assist them in getting started. One of the new air-cooled engine makers will subcontract about 65 per cent of the motor to 300 firms within a radius of several hundred miles.

Engine procurement is centered in seven auto companies: General Motors (Buick, Chevrolet, Allison), Packard, Ford, Studebaker, and Continental.

By June 1 Ford's plant was 80 per cent equipped, machinery for airplane engine production being fitted with tools and dies in the Ford toolroom and moved into the engine plant ready for operation. At least 1,000 apprentices are in training, the number may be boosted to 3,000. With the first of 4,236 Pratt & Whitney engines being built this month, it would not be surprising to see an output of 10 motors a day attained by September. Rated capacity is one engine per hour. The original plan for Ford's airplane motor plant has been raised several times, finally reaching $23,000,000 for production of $123,000,000 worth of engines.

Several of the Ford V-12 liquid-cooled, solid-injection airplane engines will be tested before commercial production begins; this may require three or four months. The engine has a unique exhaust-driven supercharger that steps-up power to sea-level characteristics at 32,000 feet. The design conserves manufacturing effort.

Studebaker to Make Wright Engines

Sometime in the Fall Studebaker will start production of Wright engines in plants at Chicago, Fort Wayne and South Bend, Ind. Although the first contracts allowed $33,657,000 for engines and $37,000,000 for plant, the government has since guaranteed $65,000,000 for jigs, dies, and equipment necessary for production. Employment should exceed 10,000.

Buick who began increasing the capacity of its aircraft division from 500 to 1,000 Pratt & Whitney engines per month by spending $5,000,000 of its own money, has been awarded an additional $88,000,000 for engines. To expand plant $10,000,000 more will probably be expended. The original contract called for $125,000,000. The first engines will be produced this fall.

Packard will begin assemblies of Rolls-Royce engines the end of this month; annual production rate of 800 will be attained by year end. Packard holds a $165,000,000 contract for 9,000 motors of which 6,000 will go to Britain, 3,000 to the U. S.

Continental Motor's program to build 500-hp. and 265-hp. Wright engines at Detroit and Muskegon respectively is meeting exacting schedules. The motors are adaptable for aircraft and tanks. Orders placed so far total $71,857,626.

Chevrolet has been awarded an $89,075,000 contract to make 5,000 Pratt & Whitney 1,200 hp. engines, the same type as being made by Buick.

WATCHING WASHINGTON

Chrysler's refusal to rescind its price increases at Henderson's request sets the stage for a battle royal. Government's price control program may need legislation for it to work successfully

By BLAINE STUBBLEFIELD

WASHINGTON — Chrysler Corporation's refusal to rescind its June 5 car price increases, in reply to OPACS Administrator Leon Henderson's request, brings the government's price control program squarely into line for a battle, probably in Congress. Chrysler's action not only forces Henderson to release other auto concerns from pledges not to raise their selling figures, but it opens the way for other refusals that might break down the entire maximum price program. For OPACS can only "request" sellers to stay under the maximum. Its only enforcement weapon is a threat to expose them to Congress and the public.

Manufacturers Should Absorb Costs

Henderson charges that Chrysler earned, after taxes, 20 million dollars in the first six months of this year, and 37 million in 1940, or 23% of invested capital. He uses these figures to point up the Administration's contention that manufacturers who can should absorb increased costs as their contribution to stopping the spiral, which will hurt everybody eventually. To Henderson's request that the $10 to $53 car price increases be rescinded, Chrysler offered to make certain concessions if OPACS would cooperate in solving Chrysler's broad problem. And Chrysler stated that, since prices were set on current models, payroll and other costs had increased $27.55, against price increases adding only $26.82 per car to income before taxes. During the year ended May 31, says Chrysler, the company delivered $31,666,171 worth of finished products for the defense program, on which it earned a profit of $13,295. The company points to its defense efforts and says "we regret earnestly that Mr. Henderson's office thought it necessary from their viewpoint to use our situation as they did, but we hope that this episode, unfortunate as it is to us, helps to bring about sound price policies generally."

Of course there are ways OPACS can bring pressure on Chrysler. Henderson says he knows of 19 measures that could be taken against the company that would cost it more than the price increase will gain for it. For instance, its essential materials could be shut off. But Henderson says this particular issue is not important, and any request for legislation, he says, is not being based on it. Undoubtedly he will put a ceiling on the automobile industry, effective August 1, as he says he will. Obviously a wild fracas could result if Chrysler or any other units refused to cooperate.

The President and his advisers have already framed a price ceiling bill which is being studied by Administration leaders in Congress. In what shape such a bill might finally be enacted nobody can guess. It could go all the way from merely putting the force of law behind Henderson's present piecemeal procedure (letting the ceiling down on one industry after another) to freezing the dollar value system of the country at status quo. Any such action, in the present situation, would amount to nothing less than total price fixing. Its implications and possible effect, in the long run, would be well beyond prediction.

But the White House at this writing was by no means certain of Congressional support for *any* kind of bill. For one thing, Russian resistance to the Nazis seemed to have moved war for the U. S. farther into the distance. The strong farm bloc on Capitol Hill, which nearly always wins, was angered by Henderson's recent ceilings on combed cotton yarn and on cotton cloth, and was ready to kill the whole price control program. Then there is always the fatalist group, which believes the price balloon is going up, come what may, so why try to hold it down. And, even if Congress were willing to control prices it might not want to delegate the authority to a single administrator.

Henderson Isn't Frustrated

Don't get the impression that Mr. Henderson feels frustrated. He doesn't. He is quick on his feet, tougher than a tea shoppe steak, and plenty confident. If he doesn't like the look of whatever Congress may offer him, if indeed he asks for anything at all, he will turn back to the President, who carries a wide assortment of big sticks under his emergency belt.

But that is speculation. Turning to the present OPACS program, here's a brief summary of its actions during the past few days:

Maximum prices were set on pig iron in a schedule issued June 25. "This is the third major factor," says Henderson, "on which action has been taken by OPACS . . . to avoid inflationary tendencies." The other two were iron and steel scrap and iron and steel products. The schedule sets forth basing point base prices for five major grades of pig iron at various cities; on three minor grades; with differentials based on silicon, phosphorous, and manganese content; and two minor exceptions. There are both domestic and export ceilings.

Three preliminary actions are being taken to prevent the necessity for the setting of ceilings: (1) Consideration of imposition of a schedule on high speed tool steel scrap and other types of high tungsten content steel scrap. Dealers and users have been asking prices higher than those of companies that produce such steel, and unless it stops, Henderson says, he will establish a ceiling; (2) Henderson invited major producers and distributors of carbon black (for rubber, paint, ink) to meet and discuss their problems; (3) he asked 16 railroad car wheel makers to withdraw proposed price increases, and to meet with him for discussion.

Three amendments were made recently to existing schedules: (1) minor adjustments designed to facilitate the flow of scrap iron and steel, Schedule 4, to consuming mills; (2) several changes, in accordance with suggestions from a cross-section of the steel industry on iron and steel products, to facilitate the operation of Schedule 6; (3) Schedule 8 on scrap containing nickel, was changed to permit importation at higher than domestic ceiling prices.

A warning was issued, June 30, against the use of subterfuges to evade the ceiling schedules, especially in the scrap and secondary aluminum and zinc trades. These include false records, setting up of phoney "agents," unwarranted feight charges, sale of dirty scrap at clean prices, sale for maximum prices of mixed metals.

MACHINERY FOR RUSSIA

WASHINGTON—The early release of $1,700,000 worth of machine tools and parts, oil field equipment and other machinery purchased here by Russia but immobilized in East and West Coast warehouses for months by export licensing restrictions, was forecast by exporters as a result of the German invasion of the Soviet. The Amtorg Trading Corp., Russian buying agency which less than a month ago was considering closing down because of an inability to get licenses for exports, is now prepared to step up her purchasing to a rate of $100,000,000 a year or more if the curb on exports to Russia is dropped. Late last week Russia officially asked for the release of materials such as machine tools, trucks, and oil-drilling machinery. This will probably be granted.

Training Within Industry Program Increases Rapidly

WASHINGTON — Rapid progress in overcoming threatened skilled labor shortages by on-the-job training of workers in defense plants is being made, indicates Sidney Hillman, associate director general, Office of Production Management, on the basis of field reports compiled by the training within industry section of the Labor Division of OPM. To date, 892 companies employing an aggregate of 1,532,000 workers working on defense contracts have installed training-within-industry systems in their plants. Of these, 42 concerns with more than 250,000 employees launched their training program the week ending June 21, 1941.

These figures refer only to those training programs which the training within industry section of the Labor Division has directly helped to install through its 22 regional offices.

"The rapid spread of training within industry," said Mr. Hillman, "enables defense plants to expand, to increase the number of shifts, and to absorb more and more semi and unskilled workers from the ranks of the unemployed. Further, the plant which trains its own workers is helping the nation to avoid the troublesome problems of labor-pirating and worker-migration." The training-within-industry section of the Labor Division is under the auspices of an advisory committee on training.

Export of Farm Implements Declines 17 Per Cent

WASHINGTON — Totaling $8,345,145, U. S. exports of farm implements and machinery in April were 17 per cent below the corresponding trade in April, 1940, which amounted to $10,013,391, it was reported by the U. S. Department of Commerce. Practically all of the export classes shared in the decline with wheel tractors registering the largest drop of 44 per cent. Exports for the first four months of 1941, however, showed very little change at $26,186,518 compared with $26,713,268 for the same period of 1940.

TRUCK BOOKINGS DECLINE

CHICAGO—Unit domestic bookings of electric industrial trucks and tractors during May declined almost 25 per cent below those of March and April, it is indicated by the Industrial Trucks Statistical Association, 208 So. LaSalle St., Chicago, Ill. May bookings totalled 320 units, as compared with May, 1940, when 103 units were booked, or an increase of about 210 per cent. Total net value of chasses only booked during May was $1,234,936. Compared with $1,557,591 in March and $1,472,225 in April and $387,503 in May, 1940.

Britain Posts Production Figures For Workers

LONDON—In British munitions factories notices are now displayed revealing to the entire personnel each day's munitions output. The plan is expected to foster a friendly spirit of competition between the workers of different factories, and so act as an incentive to higher production. The new departure is the direct result of the measured psychological effect of encouraging events acting as a stimulus in war production. This is in direct contrast to the from time to time government announcement of production in terms that evoke general optimism and yet give nothing away. These figures were comparisons with a previous comparison, which, in turn, had its origin in a comparison. Such figures were no psychological stimulus to the workers of Britain.

ORDER MORE FREIGHT CARS

WASHINGTON—Tacit admission of short planning for freight cars was implied when Ralph Budd, OPM transport head, called for 120,000 additional cars by the summer of 1942, and 150,000 by 1943. Before June was out the Priorities Division had given car builders a blanket rating of A-3 covering their purchases of materials and equipment except machine tools. This rating, though lower than ships and the most urgent defense orders would be ahead of all civilian orders and many minor defense orders. A few days earlier Leon Henderson, OPACS administrator, had ordered steelmakers to put freight cars ahead of all civilian orders. This action was taken under his authority to control civilian supply.

U. S. Government Contracts Awarded to Metal-Working Firms

(Does not include contracts under $100,000)

Source	Agency	Commodity	Amount
Peco Mfg. Corp., Philadelphia, Pa	War	Fuze parts	$1,005,280
Faries Mfg. Co., Decatur, Ill	"	Parts for primer	225,673
Midvale Co., Philadelphia, Pa	"	Tube forging	219,298
Bethlehem Steel Co., Rankin, Pa	"	Structural steel	118,080
Midvale Co., Philadelphia, Pa	"	Breech ring forgings	605,292
General Steel Castings Corp., Eddystone, Pa	"	Steel castings	171,364
Mesta Machine Co., West Homested, Pa	"	Howitzer forgings	391,050
Brass Goods Mfg. Co., Brooklyn, N. Y	"	Bullet jacket cups	135,965
High Standard Mfg. Co., New Haven, Conn	"	Machine guns	9,239,399
Auto-Ordance Corp., Bridgeport, Conn	"	Sub-machine guns	416,655
Firestone Tire & Rubber Co., Noblesville, Ind	"	Track assembly	541,800
Continental Motors Corp., Muskegon, Mich	"	Engine assys	216,876
Wisconsin Axle Div., the Timken-Detroit Axle Co., Oshkosh, Wis	"	Parts for tanks	127,400
Continental Motors Corp., Muskegon, Mich	"	" " "	156,091
Farg› Motor Corp., Detroit, Mich	"	Trucks	10,701,930
Ford Motor Co., Dearborn, Mich	"	"	865,700
American Bantam Car Co., Butler, Pa	"	"	864,141
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn	"	Sights	1,223,686
Durham Mfg. Co., Muncie, Ind	"	Antitank mines	250,000
Struthers Wells-Titusville Corp., Titusville Forge Div., Titusville, Pa	"	Howitzer forgings	144,800
General Motors Corp. (General Motors Overseas Operations Div.), New York, N. Y	"	Assembly plant equip	180,097
Caterpillar Tractor Co., Peoria, Ill	"	Crawler tractors	130,199
Gar Wood Industries, Inc., Detroit, Mich	"	Winch equipment	317,292
Gar Wood Industries, Inc., Detroit, Mich	"	Dump body hoist	195,950
General Cable Corp., New York, N. Y	"	Wire	2,915,000
Bendix Aviation Corp., Bendix Products Div., South Bend, Ind	"	Carburetor assemblies	1,344,935
Heil Co., Milwaukee, Wis	"	Trailers, trucks	5,363,489
Wisconsin Axle Div., Timken-Detroit Axle Co., Oshkosh, Wis	"	Tank parts	108,763
Continental Motors Corp., Detroit, Mich	"	Engines	101,881
International Harvester Co., Chicago, Ill	"	Trucks	130,410
Lockhead Aircraft Corp., Burbank, Calif	"	Airplanes	444,649
Mack Mfg. Corp., Allentown, Pa	"	Trucks	1,204,127
International Harvester Co., Washington, D. C	"	"	3,463,640
Bausch & Lomb Optical Co., Rochester, N. Y	"	Height finders	850,276
Fruehauf Trailer Co., Detroit, Mich	"	Semi-trailers	150,062
Republic Drill & Tool Co., Chicago, Ill	"	Drills	299,942
Reynolds Metals Co., Louisville, Ky	"	Aluminum alloy	292,856
Bendix Aviation Corp. (Eclipse Aviation Division) Bendix, N. J	"	Starter and switch assemblies	182,419
Baldwin Locomotive Works, Standard Steel Works Div., Philadelphia, Pa	"	Castings	205,104
General Steel Castings Co., Eddystone, Pa	"	"	171,364
Firth-Sterling Steel Co., Philadelphia, Pa	"	Steel	111,058
Mackintosh-Hemphill Co., Pittsburgh, Pa	"	Steel castings	180,618
Continental Motors Corp., Muskegon, Mich	"	Engine assemblies	216,876
Timken-Detroit Axle Co., Wisconsin Axle Div., Oshkosh, Wis	"	Transmissions for tanks	127,400
Breeze Corporations, Inc., Newark, N. J	"	Tank parts	397,018
Cleveland Pneumatic Tool Co., Cleveland, Ohio	"	Strut assemblies	2,621,018
Aro Equipment Corp., Bryan, Ohio	"	Pump assemblies	1,135,700
Curtiss-Wright Corp., Airplane Division, Buffalo, N. Y	"	Airplane parts	843,604
Boeing Aircraft Co., Seattle, Wash	"	" "	1,628,999
Equitable Equipment Co., Inc., New Orleans, La	"	Cargo vessels	879,000
Autocar Co., Ardmore, Pa	"	Parts	1,799,070
Midvale Co., Philadelphia, Pa	"	Forgings	835,172
Anaconda Wire & Cable Co., Marion, Ind	"	Wire	532,000
U. S. Rubber Co., Bristol, R. I	"	"	3,143,250
Okonite Co., Paterson, N. J	"	"	664,700
Auto-Ordnance Corp, Bridgeport, Conn	"	Guns	416,655

Executive Order Stops Labor Discrimination

WASHINGTON — President Roosevelt issued an executive order instructing official agencies to play their part in eliminating discrimination against negroes and members of other minority groups and establishing a committee on fair employment practice in the Office of Production Management to deal with violations. The order was issued principally because the government's attention had been called to cases of discrimination against negroes in some defense industries.

"It is the duty of employers and of labor organizations to provide for the full and equitable participation of all workers in the defense industries without discrimination," said the President.

The new unit of the OPM has been instructed to "receive and investigate complaints of discrimination and violation of the provisions of this order" and to take "appropriate steps to redress grievances which it finds to be valid."

NAMES in the NEWS

T. B. Bechaud, Fond du Lac, Wis., has been elected president of the Scientific Lighting, Inc. He succeeds W. L. Mack, Chicago, who resigned as president, director and sales manager.

H. F. Berryman and Paul E. Schmitz have been elected vice-presidents, National Can Co., New York, N. Y.

M. S. Brooks has been appointed assistant to the vice-president in charge of sales, the Studebaker Corp.

John F. Byrne has been appointed general manager of the newly created blast furnace division, Koppers United Co., Pittsburgh, Pa. The division includes two blast furnaces which have been purchased from the Granite City Pig Iron Co., Granite City, Ill. He has been associated with Koppers since 1925 when he joined the company in Chicago as a research chemist.

Col. Harrison W. Flickinger, director, export sales, and C. Hart Miller, director of military contracts, have been appointed vice-presidents, Republic Aviation Corp., Farmingdale, N. Y. Col. Flickinger who has headed the export sales organization since his retirement from active duty with the U. S. Army Air Corps in 1939, negotiated Republic's large contracts with Sweden. He currently directs the corporation's materiel organization. C. Hart Miller has been associated with the company since 1935 as project engineer, assistant to the president and head of the military contracts department. In his present capacity he handled negotiations leading to Republic's $65,000,000 worth of orders for pursuit planes.

Newly Appointed Vice-Presidents at Republic Aviation Corp.

COL. HARRISON W. FLICKINGER

C. HART MILLER

Fred W. Ford has been named purchasing agent of Ryan Aeronautical Co., San Diego, Calif.

Fred V. Gardner has been elected president, the Smith Steel Foundry Co., Milwaukee, Wis., succeeding Edward A. Bacon, who has been named chairman of the board.

Frederick C. Gladeck, consulting engineer, has joined the Machine Tool & Designing Co., Philadelphia, Pa. He had been chief engineer, the American Machine & Foundry Co., Brooklyn, N. Y., for 16 years. He has also served as superintendent of the Eddystone Ammunition Co., Eddystone, Pa. and general manager of the designing and experimental department of the Frankford Arsenal.

Frank B. Harrington, assistant plant manager of the Lansing Fisher Body Division, has been named acting manager for Fisher Body's Flint Division Plant. Louis P. Cramer will succeed Mr. Harrington as assistant plant manager.

E. J. Hergenroether, who has been research engineer for International Nickel Co., Inc., is now associated with the OPM on the program for substitutions in the production division of the conservation section.

R. G. Koch who for the past few years has been managing the steel department of H. Boker & Co., Inc., New York, N. Y., and who prior to acting in this capacity was sales representative in the New York State and Eastern Pennsylvania territory, has recently been appointed vice-president.

L. C. La France has been appointed special representative for the Eastern Division, Hudson Motor Car Co. Ross Williams, formerly zone manager for the Washington, D. C. territory, has been transferred to Detroit as regional manager.

Ross O. Laub has been appointed plant industrial engineer at the Gary Sheet & Tin Mill, Carnegie-Illinois Steel Corp. He succeeds Howard J. Stephens who has been transferred to the company's Pittsburgh office.

C. M. Maratta, maintenance engineer for the Timken Roller Bearing Co. since 1921, has been appointed chief works engineer to fill the vacancy left through the death of W. C. Makley some months ago.

Walter F. Green has been appointed assistant works engineer, Timken Roller Bearing Co., Canton, Ohio. Putney L. Wright, with Timken since 1938, has been named plant engineer. Harry McCool, Jr. has been appointed Southwestern sales representative for the Steel and Tube Division. He joined the Timken company in 1928 as hot mill operator.

Charles D. Mills has been appointed manager, raw materials, steel and power division, Pittsburgh district, Carnegie-Illinois Steel Corp. He succeeds C. B. Getsinger who was recently appointed supervisor of fuel and power.

Oliver T. Osborne, president, the Lock Steel Chain Co., Bridgeport, Conn., has been elected a director of the Bridgeport City Trust Co.

H. H. Rothrock, formerly head of the industrial engineering department, University of Pittsburgh, has been named assistant to the chief industrial engineer, Carnegie-Illinois Steel Corp., Pittsburgh. At one time he was associated with the Westinghouse Electric & Mfg. Co.

Fred H. Schuster completed his 50th year with the Pratt & Whitney Division of Niles-Bement-Pond Co., West Hartford, Conn., on June 24, when he was honored by the company. He was presented with a wrist watch, a $50 bill and a large basket of flowers from his associates. Later he will receive a gold emblem containing a large single diamond in recognition of his service. He became associated with the company in 1891 as a 17-year-old apprentice mechanic. He has since become

W. L. SCHNEIDER

T. F. SCANNELL

Their appointments as vice-president in charge of sales and sales manager respectively, The Falk Corp., Milwaukee, have been announced in these columns

one of the company's most skilled workmen.

H. F. Zimmerman, superintendent of electrical maintenance of the Gary Sheet & Tin Mill, Carnegie-Illinois Steel Corp., has been elected chairman of the Chicago section, association of iron and steel engineers for the 1941-42 season.

PLANT EXPANSION

Air Associates, Glendale, Calif., will erect a new aircraft factory at Los Angeles. The building which will cost $54,000 will have ground dimensions of 200 x 200 ft.

The American Metal Bearing Co., Los Angeles, will build a new plant comprising a total area of 2,200 sq.ft.

The Midland Machine Corp., Chicago, recently formed, has more recently bought a large manufacturing plant which will soon be remodeled and equipped with new machinery, pneumatic pumps and pump machinery for Navy use and for industrial purposes. R. W. Glasner, president of the company, also serves as president of the Clearing Machine Corp. George Habicht, president, Marshall and Huschart Machinery Co., is vice president of the new concern. George W. Sondheim is secretary and general counsel. The company paid $63,000 for its new plant and will spent $100,000 for new equipment. The building contains 32,000 sq.ft. of floor space.

O'Keefe & Merritt Co., Los Angeles, is erecting a new factory at a cost of $20,000. The new building will cover an area of 105 x 133 ft.

Vancouver Iron Works Limited, Vancouver, B. C., is erecting a $30,000 extension to its factory.

The Warner & Swasey Co., Cleveland, Ohio, has leased the basement and three floors of a new building which adds approximately 91,000 sq.ft. of floor space to its present manufacturing capacity.

The Wire & Metal Mfg. Co., Los Angeles, is erecting a new factory building at a cost of $18,000. The structure will be 60 x 200 ft. in area.

Lyon Iron Works, Greene, N. Y., manufacturers of hydraulic and material handling machinery, has just completed a 50 per cent increase in its production floor space.

General Electric Co. will construct two new plants for the manufacture of propulsion equipment for merchant ships. The plants will be situated in Erie, Pa. and Lynn, Mass. and will be financed by the Defense Plant Corp. under a lease agreement at a total cost of between 20 and 25 million dollars. Turbines will be manufactured in the Erie Plant and reduction gears in the Lynn plant. Starting in 1942 the plants will produce 100 turbines and 50 gear equipments a year. Production is under contract to the Maritime Commission. The plants, adding some 475,000 sq.ft. of floor space to G.E.'s production, will employ about 2,000 persons. Plant expansion already under construction, including the two new plants, total 2,675,000 sq.ft. of floor space. This is more than one-third of the former size of the G.E. plant in Schenectady, N. Y.

BUSINESS ITEMS

Botwinick Bros., Inc., machine tool rebuilders, have moved to 333 Welton St., New Haven, Conn. The new plant and offices occupy over 70,000 sq.ft. and has been equipped with the latest facilities.

Industrial Products Co. has moved to larger quarters at 2820 N. 4th St., Philadelphia, Pa.

Maute Die & Tool Works has moved to 861 Jefferson Ave., Buffalo, N. Y.

Meta-Mold Casting Co. has been incorporated recently in Los Angeles with Walter Rachael, James C. Titus and William D. Witherspoon serving as directors.

Torms Aircraft Engineering Corp., Los Angeles, has been incorporated with a capital of $25,000. Directors are: George L. Duke, Eileen Ray, and C. I. Sweet.

Hart-Carter Corp., Peoria, Ill., has purchased the Lauson Mfg. Co., New Holstein, Wis. The Lauson firm will continue to operate as usual with no changes in personnel. E. A. Longnecker remains as president.

OBITUARIES

Frederick Ahrens, 70, one of the founders of the Waukesha Motor Co., Waukesha, Wis., died recently in a Milwaukee hospital. After several years, Mr. Ahrens left the Waukesha Motor Co. to become associated with a steel mill in Gary, Ind., where he remained until about a year ago.

George L. Bennett, 69, formerly president, G. L. Bennett Machine Tool Co., now the Bennett-Raskin Machine Tool Co., New York, N. Y., died of heart disease on June 3. He had retired in 1932.

Louis Chevrolet, who organized the Chevrolet Motor Car Co. in 1911 and headed the concern until 1915, died recently in Detroit. With his brother, Arthur, he had organized the Chevrolet Bros. Aircraft Co. in 1928.

Warren Gilman Jones, 51, president, W. A. Jones Foundry & Machine Co., Chicago, succumbed to a heart attack and passed away at his home in River Forest, Ill., on June 6. He had been president of the company since 1925. At one time he was also vice-president, the Sackett Screen & Chute Co., Chicago.

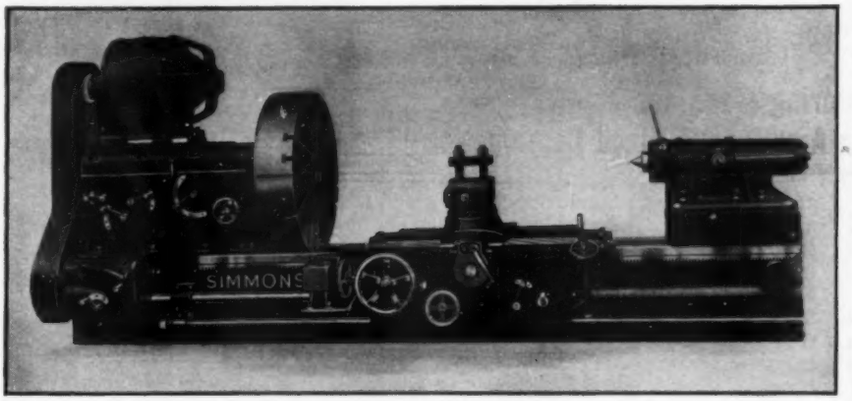
Roy L. Smith, 53, superintendent of construction, Engineering & Construction Div., Koppers Co., Pittsburgh, Pa., died on June 22, following a brief illness. He joined the Koppers Co. in 1916 as a field and erecting engineer. In 1925 he was made assistant superintendent of construction and in 1936 he was made superintendent, a position he held at the time of his death.

MEETINGS

Conference on Industrial Relations. Silver Bay on Lake George, N. Y., July 23-26.

SHOP EQUIPMENT NEWS

Simmons 48-In. Heavy Duty Engine Lathe Has Extra Wide Bed, Is Rigidly Constructed



The Simmons Machine Tool Corp., Albany, N. Y., has just announced a new 48-in. engine lathe designed for heavy machining operations. Bed design is extra wide and rigidly constructed to give ample support to the carriage and firm foundation for headstock and tailstock. Wide flat ways are provided for extra bearing to the carriage. Headstock, carriage and tailstock all have exceptionally long bearing on the ways for rigidity and strength.

The head is fully inclosed and all bearings and gears are constantly lubricated from positive pressure oil pump. Spindle bearings are extra long and large in diameter to compensate for heaviest loads. All shafts and gears are made of carbon-chrome-molybdenum steel, SAE 4640, and are heat-treated. Speed changes are provided to main spindle through sliding spur tooth gears and one heavy jaw clutch.

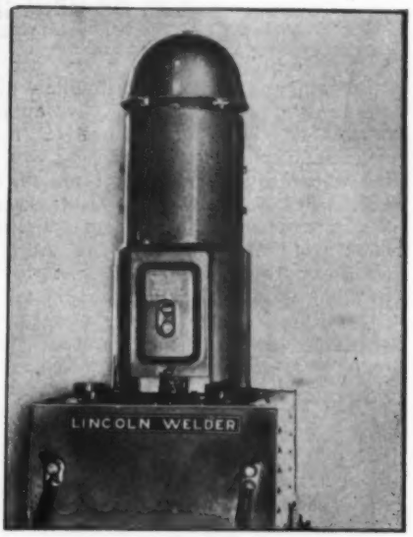
The carriage bridge is wide and deep, properly compensating for heavy tool thrust loads. The carriage has double gibs and can be securely locked in any position for heavy duty cross feeding. Power and hand feed are provided for lateral, cross and angular movements. Power rapid traverse can be provided for one or more carriages along the bed. Apron is of double walled construction with heavy bearing support for all shafts and studs. All gears are of chrome nickel alloy steel, SAE 3140, with wide face and coarse pitch to increase pulling strength. All speed levers are conveniently located. Lead screw is 2 1/8 in. diameter and is made from high-carbon steel turned and ground.

Specifications: Swing over bed, 50 in.; swing over carriage, 36 in.; distance between centers (20-ft. bed), 10 ft. 6 in. Nine gear changes are provided, giving a range of spindle speeds (500 to 1,200-r.p.m., d.c. motor) from 1.9 to 112 r.p.m. Hole through spindle is 2¾ in. in diameter. Tailstock spindle diameter is 6 in.; spindle travel is 20 in. Speed gear box gives 32 feed and thread changes. From 1 to 14 threads per in. can be cut; feeds per revolution range from 0.021 to 0.296 in. Diameter of face plate is 48 in. Recommended motor horsepower is 30 to 50 hp.

Lincoln Announces Arc Welders Designed for Aircraft Welding

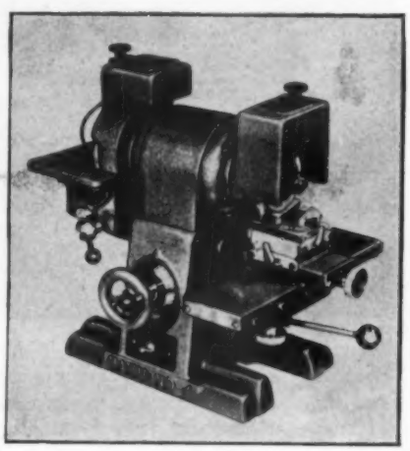
Finely accurate settings of welding current and voltage control which are essential for welding the particular analyses and gages of metal employed in modern plane construction are a feature of a new arc-welding machine developed by the Lincoln Electric Co., 12818 Coit Rd., Cleveland, Ohio. The current control on the aircraft welder, known as "dual continuous control" permits independent adjustment of both welding current and voltage to obtain just the right type and intensity of welding arc. Adjustable in a continuous sequence of fine increments, the control avoids compromise settings which sacrifice welding speed or quality.

Another feature of the new welder is its current range and capacity. It is suitable for welding the lighter gages of aircraft steels; the unit delivers 10 amp. at the arc without extra attachments. The welder's range also adapts it for heavy materials. The machine is of the motor-generator, single operator, variable voltage type with laminated pole pieces. Connections are readily accessible for either 220 or 440 volts. It is available in two models: 150 and 200 amp. sizes, either portable or stationary. Current range for the 150 amp. model is 10 to 200 amp., and for the 200 amp. model is 10 to 250 amp.



Hammond Chip-Breaker Grinder Has Universal-Angle Tool Vise

Three separate planes of adjustment for setting the grinding angle when grinding chip-breaker grooves in carbide tools is provided by the new tool vise featured in the new Model 4 machine manufactured by Hammond Machinery Builders, Inc., 1618 Douglas Ave., Kalamazoo, Mich. Each plane adjusts by means of accurately scaled readings. The vise consists of two



closely machined steel blocks rounded on the bottom, cradled into each other at right angles and locked together after adjustment by means of cam locks operating in machined segments located on ends of the respective blocks. Mounted atop these two blocks is a flat, circular piece which swivels 90 deg. from center of any of the four sides of the block below. This piece carries the vise jaws, holding tools firmly by means of Allen screws. After the tool has been mounted in the vise at the desired angle and locked, the entire unit is cranked upward into contact with the grinding wheel by a few revolutions of the calibrated handwheel at the front of the machine.

The Hammond "4" chip-breaker grinder is powered with a ball-bearing, ½-hp., heavy duty, reversible type motor permitting right- or left-hand grinding. The machine is furnished either as a bench or floor model. For wet grinding a coolant tank with flow controlled by a needle valve is mounted over the 4-in. diamond wheel.

Cleveland Four-Point Press Features Compact Construction

Modern four point press made by Cleveland Punch & Shear Works Co., 3900 St. Clair Ave., Cleveland, Ohio, measures 108 in. between the uprights and exerts a pressure of 500 tons. The press is identical front and back and there are no overhanging brackets or other projections, a feature which contributes to a more rugged type of construction and reduces overall dimensions to a minimum.

The gears, which are located in the box type crown together with the drive unit, run in oil and there is an overflow limit in all gear housings to permit excess oil to return to the reservoir in the slide. All bearings are lubricated by automatic pump.

The press is operated through an electrically controlled, hydraulically

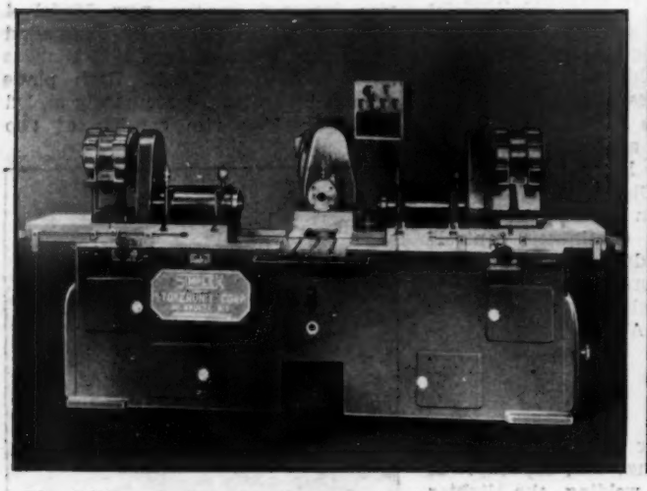
Simplex Unit Type Precision Boring Machines Can Be Built In Any Standardized Combination

A new technique of design and construction, and a new coordination of mechanical, electrical and hydraulic devices has been incorporated in the new Simplex unit type precision boring machines announced by Stokerunit Corp., 4546 W. Mitchell St., Milwaukee, Wis. The machines consist of a series of sizes of standardized spindles, tables, hydraulic feed systems and electrical controls which can be combined singly or in any multiple to bed units constructed especially to suit production requirements. Welded construction of steel beds equipped with hardened, ground and lapped steel ways permits size and structural modification, enabling a machine to be fitted closely to a certain job.

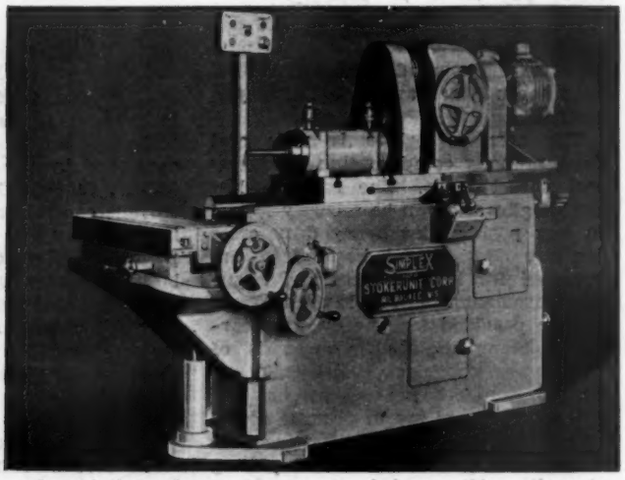
Tables are heavy sliding members of fine semi-steel rough machined, normalized, finished and scraped to a fine fit on the hardened ways. They provide ample space for mounting spindle, spindle drive and driving motor. The spindle head is a heavy casting, rough machined, normalized and precision finished. The spindle itself is of carefully selected alloy steel, machined, hardened and ground. A clamping ring carries graduations showing the adjustment of the tool in tenths of thousandths, and finer adjustments can be easily made. Driving power is applied to the spindles through V-belt and sheaves which are easily interchangeable to provide different speeds.

These unit type machines can readily be tooled up to do precision boring and facing when used with the Nos. 1, 1-L, 3 or 4 Simplex Precision Boring Heads. Spindle speeds from 300 to 6,000 r.p.m. can be obtained with Nos. 1 and 1-L heads; 300 to 3,500 r.p.m. on No. 3 heads, and 200 to 2,500 r.p.m. on the heavy duty No. 4 head.

When the tables are mounted on dovetail ways instead of V and flat ways used for boring operations, drilling and milling operations can also be performed. Taper and straight turning work can be accomplished by mounting the work on the spindle and setting the head at the required angle, or by mounting the work and the spindle in line with the table travel for straight turning.



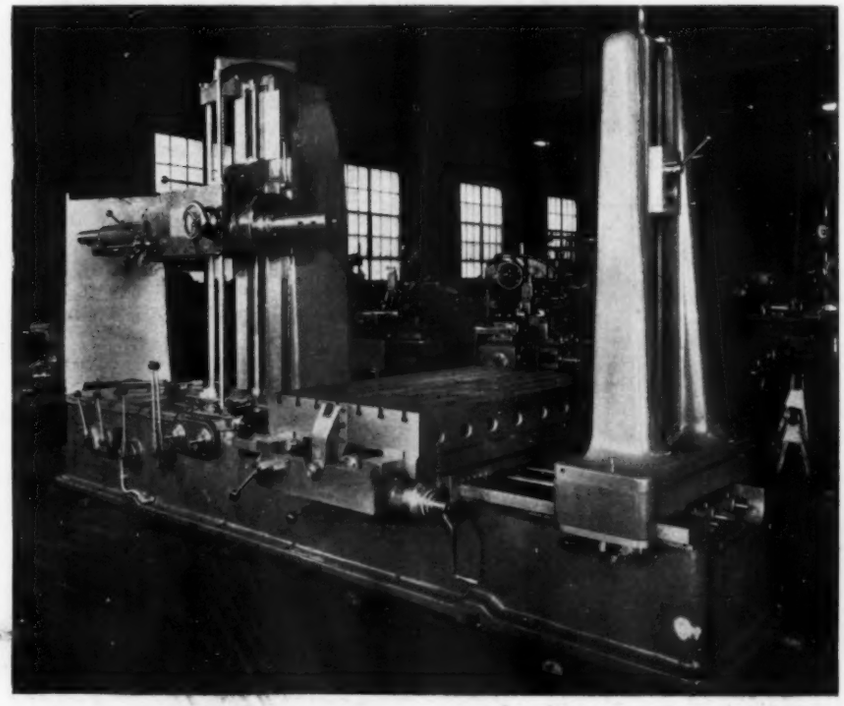
Flexibility of the Simplex unit design for boring machines is shown in this machine with three-way bed, and three No. 3 spindles. Single end, double end, four-way and angular type beds can also be supplied



Units incorporated in this Simplex knee-type precision boring machine are No. 3 spindle, variable speed spindle drive, and turret stop for table. The knee simplifies work fixtures required and reduces set-up time

operated friction clutch and brake. Flywheel is provided with a separate air brake to bring it to a quick stop when power is shut off. Slide is counterbalanced by air, the cylinders being inclosed in the uprights. Openings in the uprights permit automatic feed when it is desired to feed material right and left across the dies. Pockets are also provided in the uprights for electrical equipment. This press operates at the rate of 14 strokes per min., has 24-in. stroke and 6-in. adjustment to the slide.

Portage Horizontal Milling & Drilling Machine Features Speed, Rigidity and Accuracy



Designed to meet demands for speed, rigidity and accuracy, the new horizontal boring, drilling and milling machine of the Portage Machine Co., Miami and Cross Sts., Akron, Ohio, has rigidly constructed frame members. Bed is unusually wide and deep, with integrally cast gear case. Column is a rigid box section strongly braced internally by horizontal and vertical ribs. The spindle saddle is designed with a liberal bearing surface on the face of the column, and has an adjustable taper gib for adjustment of alignment. Vertical movement of the saddle is direct and accurate. Units comprising the spindle and saddle are counterbalanced by a weight within the column, thus relieving the elevating screw of wear and tension.

Spindle is of Nitralloy steel with Nitralloy bushings. The front bearings are double roller and the rear bearing is precision roller allowing for expansion of the spindle when heavy milling is being done. The boring bar support is raised or lowered in unison with the spindle saddle, and can be clamped by a lever at any position. All spindle drive shafts are of high carbon steel, and all gears are heat-treated alloy steel. Speed changes are made by a single lever on the saddle for the back gears and by two levers mounted on the cover on the base of the machine. Speed changes are made by two levers at the lower left of the base. A double reversing Pullmore clutch is operated by a single lever on the front of the machine.

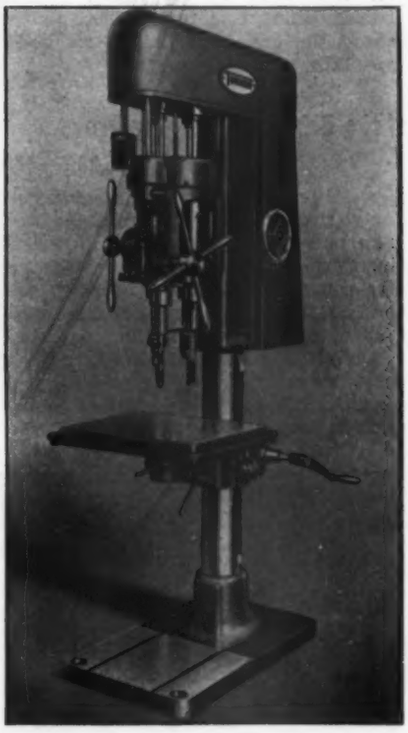
Bed surfaces are designed for a long, deep, rugged saddle to compensate for any overhang of the table at the extreme front or rear position. Power rapid traverse of a friction type is provided for all members operated by the feed; regardless of the feed, rapid traverse always operates at one rate of speed in either direction. Adjustments by hand are provided in addition to the automatic feeds for the spindle saddle, spindle travel, table saddle, and table.

Diameter of spindle is 4 in., spindle traverse is 30 in. Range of standard speed is from 16 to 610 r.p.m.; range of feed per spindle revolution is from 0.003 to 0.472 in. Maximum distance from face plate to outer support is 7 ft. 6 in.; maximum distance from top of table to center line of spindle is 48 in. Cross travel of table is 48 in.

Model "B" Turner Drill Press Has Four-Spindle Turret Head

Operating principle of a new four-spindle turret drill press announced by the Turner Machine Co., Inc., Danbury, Conn., is that the turret is carried on a vertical spindle, about which it revolves horizontally to index the different spindles into working position. Only the spindle in the operating position revolves. The machine is designed with a turret case that holds the turret rigidly; a detent and socket locks the turret against rotary motion. Spindles are equipped with ball and roller bearings. The machine is built to take No. 2 Morse Taper shanks and will handle drills up to $\frac{33}{64}$ in. and taps up to ½ in.

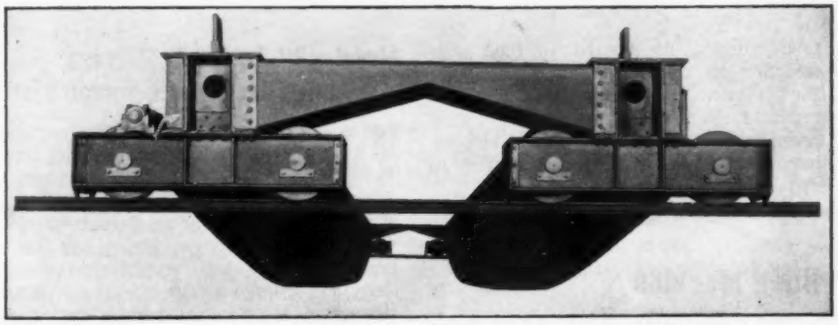
The operator can index these spindles easily and quickly so that different operations can be done without moving the work from one spindle to another. The table will tilt to different positions and can be moved to one side so that work can be held



on the base plate. The machine is driven by ball bearing motor and V-belt. Spindle speeds are controlled by a single hand wheel which will give infinite variations within its range. For drilling, three of the spindles have a speed range of 250 to 1,620 r.p.m. and the spindle for tapping has a speed range of 85 to 540 r.p.m.

Spring-Type End Tie Designed For Large Cleveland Cranes

A novel crane end tie which is extremely simple in design has been developed by the Cleveland Crane and Engineering Co., Wickliffe, Ohio, for

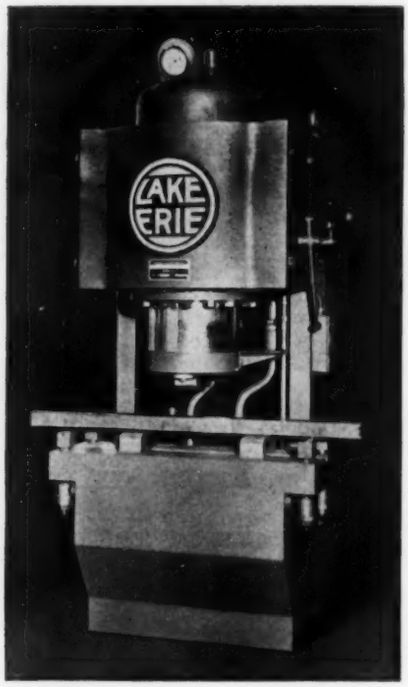


large heavy-capacity cranes of the type used for power houses and for other moderate services requiring eight bridge track wheels. The tie is made of one heavy rolled steel plate that is first cut to shape and then bent to form a box section. Bending is done cold on a Steelweld bending press. Into the box section are welded reinforcing diaphragms to effect the rigidity required. This end tie construction is known as a spring type, since it has sufficient "give" or spring to allow all wheels to bear properly on the track at all times, despite runway irregularities. The picture shows the end tie of a 100-ton, 90-ft. span Cleveland crane.

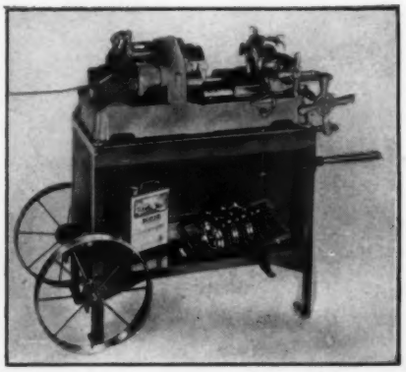
Lake Erie Straightening Press Handles Long Bars

Special features of a new line of heavy-duty hydraulic straightening presses, announced by the Lake Erie Engineering Corp., Buffalo, N. Y., are a C-frame for convenient handling of long bars, and fast operation with sensitive control of pressure and stroke.

Bed is fitted with V-blocks adjustable to suit work. Spring rollers at ends facilitate movement of bars. Control is by means of a conveniently located hand lever, operation of which determines desired pressure. Pumping unit is located at bottom and back of press. Complete data and specifications on various sizes are available.



Warren Portable Carriages Transport Small Machine Tools



Constructed to enable workmen to wheel awkward-to-handle, heavy, and lightweight but hitherto stationary machines direct to the job rather than carrying the work back and forth through tool rooms or the factory, a new portable carriage has been developed by Warren Steel Specialties Corp., Warren, Ohio. The carriage is constructed of angle iron, channel, and heavy-gage auto body sheets welded together. It has handles for the workmen who, without helpers, can lift and guide the apparatus direct to their bench or job where it will then remain stationary.

The Warren carriages are available in any practical size. The manufacturer says they are ideal in factories which, during this preparedness rush, are crowded; also for manufacturers where more than one man uses the same tool or machine at different intervals.

Protective Coating for Aluminum Castings Announced by Glyco

In order to protect aluminum castings against corrosion caused by condensation of water vapor, it is necessary to have some form of protective coating. It has been found that an emulsion of paraffin wax and Flexo Wax C, made with Diglycol Stearate S, both products of the Glyco Products Co. Inc., 230 King St., Brooklyn, N. Y., can be easily applied to the castings by spraying in the cold, leaving a film of water-repellant wax which completely protects the metal parts. This emulsion has also given very satisfactory results on extruded parts, alumilited sheets, zinc and tin plated parts.

Standard Electrical Announces Heavy Duty Wet Grinders

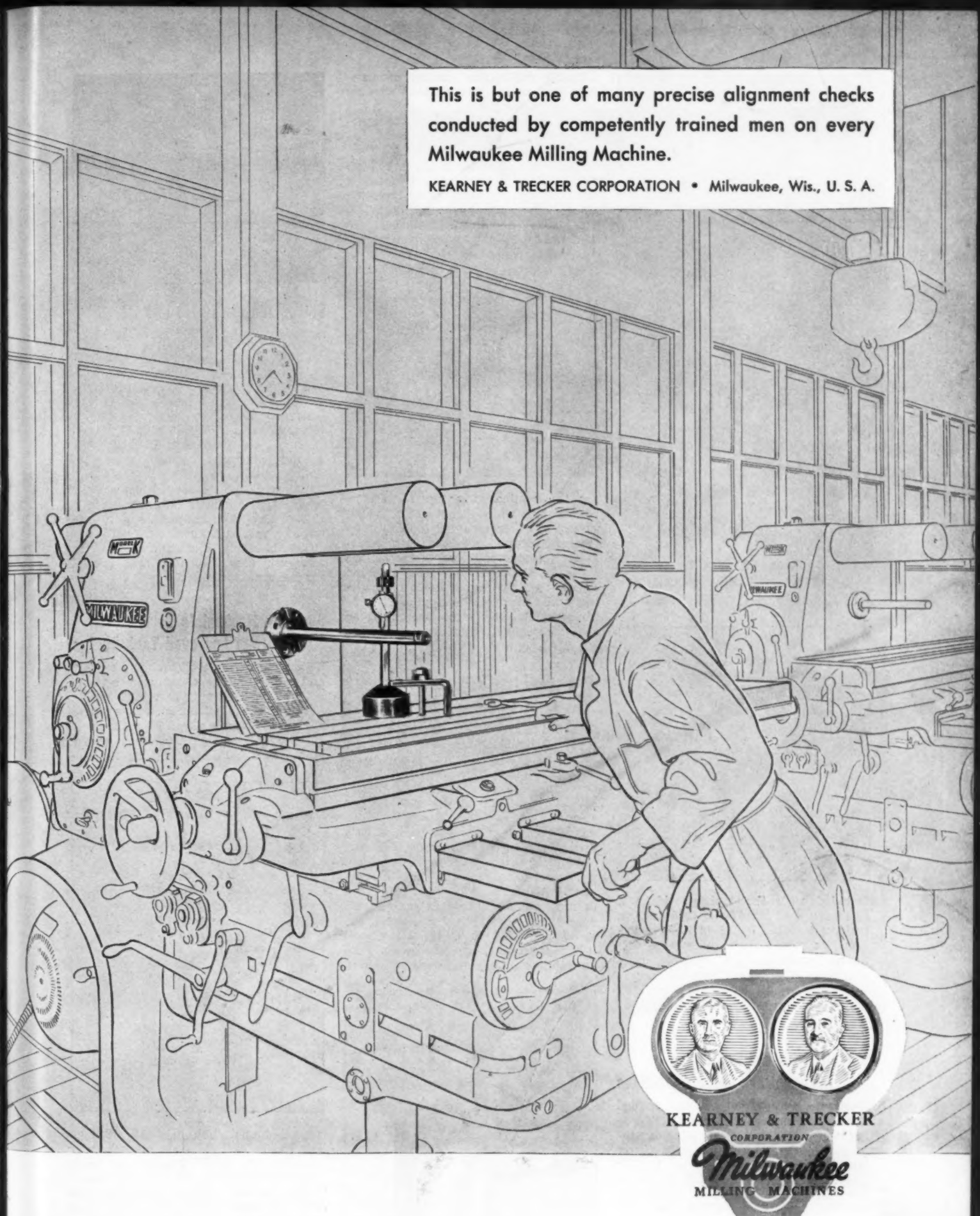
A new line of 12-in. and 14-in. heavy duty wet grinders developed by The Standard Electrical Tool Co., 1940 W. 8th St., Cincinnati, Ohio, features a wet grinding hood with integral splash bowl and adjustable work rest. Equipment on each guard includes a valve for controlling the flow of water, adjustable nozzle and suitable piping. Bottom of guard trough is fitted with hose connection for gravity return of water to tank.

A motor-driven pump secured to the back of pedestal delivers water to each guard through piping. The pump has capacity of 10 gal. per min. Both the grinder motor and pump motor are operated simultaneously through

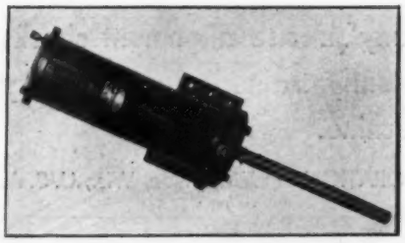
the push button safety starter at front of machine. This machine is also available as a combination wet and dry grinder. Safety hinge door guard for dry grinding can be located on either left-hand or right-hand side.

Dayton Rogers' Cylinders Counterbalance Press Rams

Designed for large, straight-side punch press equipment, a new Model GT counterbalance cylinder is announced by the Dayton Rogers Manufacturing Co., 2830 Thirteenth Avenue South, Minneapolis, Minn. These pneumatic counterbalance cylinders operate directly from the air line system in the average shop and serve to counterbalance the rams on the larger straight-side presses, compensating for the increase or decrease in the size of the die tooling equipment fastened to the press ram. This counterbalance


This is but one of many precise alignment checks conducted by competently trained men on every Milwaukee Milling Machine.
KEARNEY & TRECKER CORPORATION • Milwaukee, Wis., U. S. A.
MILWAUKEE
KEARNEY & TRECKER
CORPORATION
Milwaukee
MILLING MACHINES

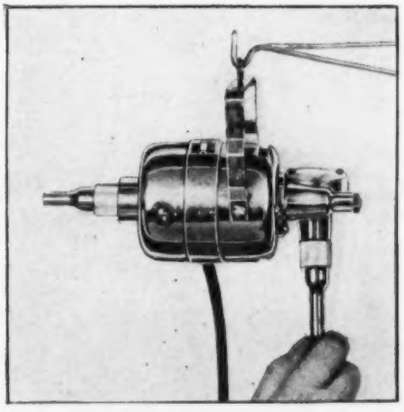
Milwaukee MILLING MACHINES



compensator is regulated by a combination regulator and air pressure gage furnished. The counterbalance cylinders are installed in groups of 2, 4 or 6 and automatically take up the lost motion due to the wear of the parts and the large clutch mechanisms. This lost motion is especially objectionable on large dies both in forming and blanking operations. Cylinders are made from 6 to 14 in. dia. having strokes ranging from 12 to 24 in.

Foredom Flexible Shaft Tool Has Wide Range of Speeds

Flexible shaft and hand-piece assembly of the new 400 Series tools developed by Foredom Electric Co., 27 Park Pl., New York, N. Y., can be quickly attached to either the geared end for low speeds or to the motor shaft direct for high speeds. A six-step foot-operated speed control is

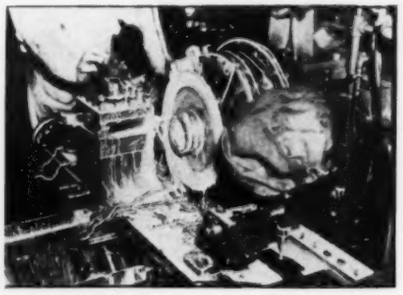


included with the tool, providing a speed range of from 500 to 14,000 r.p.m. Universal motor has 1/12 hp.; reduction is through worm gears. Five different handpieces are available, some as small as a pencil and all having the quick-detachable feature making it possible to use just the right type of tool for the work at hand.

Detroit Universal Duplicator Applicable to Lathe Operations

Eliminating forming tools, spoiled work, and special skill in contour turning work, portable duplicating equipment used in conjunction with turret lathes has been designed by Detroit Universal Duplicator Co., 253 St. Aubin Ave., Detroit, Mich. These duplicators provide means of handling such work on standard turret lathes without special equipment by employing a detachable duplicating control mechanism that makes the contour turning entirely automatic.

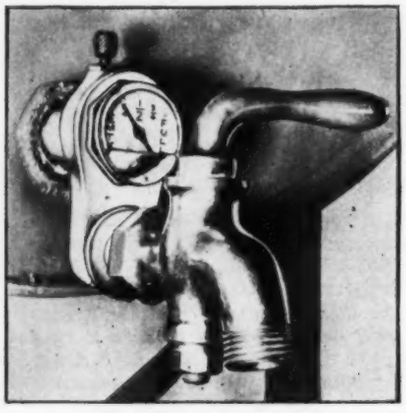
On one job at the Spicer Manufacturing Co., Toledo, Ohio, a steel forging is turned to size and finished on both faces. The work has a reverse curve which would require forming tools and considerable care in handling if done by manual control. For this work two Acme turret lathes are equipped with duplicating control attachments consisting essentially of a tracer which follows a metal templet

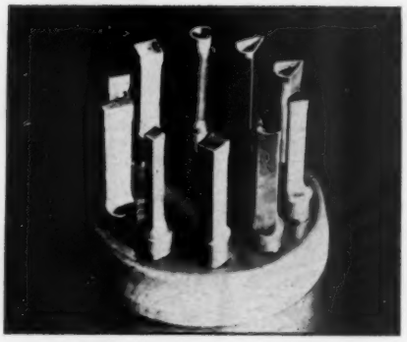


for the outline of the work, and a control unit which it actuates through a series of interrupted contacts by electro-hydraulic means. The duplicator actuates the feed screw of the lathe. Cross-feed is by the machine itself. One cut serves as both roughing and finishing, the duplicator supplying sufficiently close accuracies so that subsequent finishing operations are not required.

U. C. Indicator Tells Level Of Liquid in 55-Gal. Drums

Designed to give constant check on contents of liquids which are stored in standard 55-gal. steel drums, a new level indicator unit made by U. C. Level Indicator, 624 East Locust Street, Milwaukee, Wis., screws into faucet opening of the drum. It is threaded to receive any type of spigot or faucet using the standard type fitting. Amount of liquid in the drum is clearly visible at all times on the glass-inclosed gage. Although it is not calibrated to show actual content in gallons, the gage indicates whether drum content stands at "full," ¾, ½, ¼, or "empty." When drum is empty, the entire gage assembly is quickly and easily removed.





Set of Ten Slotting Tools Accessory to Slotmaster

An assortment of ten high-speed steel slotting tools is announced by Experimental Tool & Die Co., 12605 Greiner, Detroit, Mich., as accessories to the Universal Slotmaster. The Slotmaster (described A.M. Vol. 85, p. 88) is a slotting head that can be used on all milling machines providing double duty facilities. With these tools, the Slotmaster can be used as a vertical or horizontal slotter and shaper for cutting key-ways, templets, splines, internal gears, and for slotting out precision blanking dies and molds, or wherever sharp corners and special shapes are machined.

Superior Mechanic's Torch Has Improved Tank Design

Superior Mechanic's Torches Nos. 141 and 142, recently announced by the P. Wall Mfg. Supply Co., 3126 Preble Ave., No. Side Pittsburgh, Pa., consists of the long-popular Wall No. 41 burner, mounted on a highly polished drawn brass tank. Filler plug is in the

funnel-shaped bottom. All fittings and the bottom plate are mechanically locked to the shell. The No. 141 torch is for gasoline; No. 142 is for kerosene.

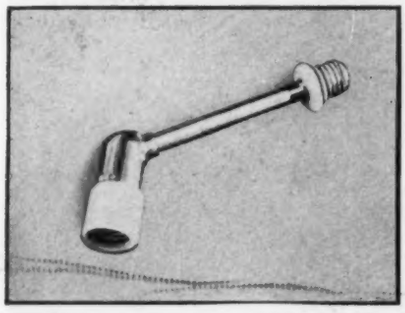
The burner casting surrounds the fuel vein, which is of extra heavy steel tubing, assuring complete generation, intense heat and long life. It is

EUGENE (JACK) PHILLIPS, 1117 Cleckler South, Fort Worth, Texas, winner of first prize of $5,000 in the Revere Award for the idea doing most to help speed America's industrial defense program. Tall and lanky, Phillips is 33 years old and employed as senior radio electrician with the C. A. A. central depot at Fort Worth. When a close friend, Captain Jerry Marshall, crashed in Arkansas in landing an airplane, Phillips immediately set to work on his prize winning idea—an improved method of blind landing. He studied nights, gave up car, vacations and other pleasures for necessary equipment. His wife predicts most of the prize money will be spent for new equipment. He has three children, Patricia, 7; Kenneth, 4; James, 8 months.

The men and management of Revere Copper and Brass Incorporated are proud that the first Award of $5,000 goes to a man like Phillips. We also wish to thank the thousands of other American workmen for their splendid loyalty and cooperation in this effort to speed up industrial defense. Revere Copper and Brass Incorporated, 230 Park Avenue, New York.

equipped with windshield and is not affected by the coldest and windiest weather. Cleaner pin in end of valve shaft cannot enlarge orifice. Bakelite control wheel stays cool. Pump has blow-proof construction originated by Wall.

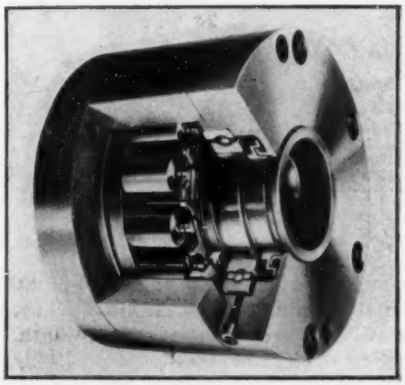
Swivelier Lighting Socket Is Adjustable to Any Angle



Consisting of the Swivelier socket attached to a tube, this new extension socket announced by Reliance Devices Co., Inc., 140 Liberty St., New York, N. Y., is adaptable to any lighting conditions where full angular adjustability is required. The rod comes in any length, straight or curved, to meet any unusual lighting problems. The socket can be adjusted vertically to a full 90 deg. right angle. The socket can be rotated in full 360-deg. circles when adjusted at any angle. A special stop keeps wires from twisting. Vibration will not cause the socket to loosen, hence it can be mounted on a machine.

Morse Indexing Clutches Replace Ratchets in Feed Rolls

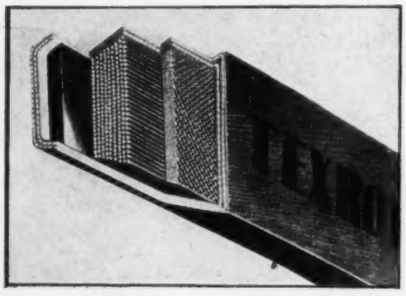
The improved indexing clutch manufactured by Morse Chain Co., Div. of Borg-Warner Corp., Detroit, Mich., is claimed to be specially suitable for feeding a variety of sizes of steel, rubber, leather and felt stocks, in round, tabular, square, flat and rectangular shapes. Rate of stock feed for punching, stamping and slicing can be greatly increased and amount of stock required between punching can be reduced to a minimum because of greater indexing accuracy. The clutch is also used as a back stop on indexing roll feeds.



The clutch consists of three primary elements—driver, driven and cam clutching members. The wedging cams are always in light contact with both driver and driven members; they instantly lock these members together when torque is applied. When application of torque ceases, the cams instantly unlock, permitting the driver member to rotate to indexing position on return stroke. In effect, the clutch is a self-contained ratchet of an infinite number of teeth. Varying indexing adjustments do not alter the feed accuracy. Available in 12 standard sizes with torque capacities ranging from 26 to 6,300 ft.-lb.

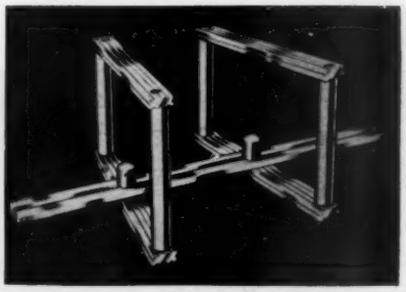
Smaller Cords Increase Strength Of "Super-7" Texrope V-Belts

Cords in the new "Super 7" V-belts made by Allis-Chalmers Manufacturing Co., Milwaukee, Wis., are smaller, permitting the use of more cords per belt with a resulting greater strength and less stretch. Each cord is individually imbedded in heat dissipating rubber to reduce internal belt degeneration. These belts are made in matched sets to assure uniform, smooth running, highly efficient drives. Each element of the belt is designed to fulfill an individual function. The live rubber bottom cushion absorbs impacts of operation. The central cord portion transmits power at the effective pitch diameter. The bias-cut fabric prevents dishing and assures transverse stability. The 2-ply rubber-impregnated fabric cover prevents destructive agents from reaching the vital belt elements, resulting in a high friction co-efficient between belt and sheave walls. All Texrope V-Belts are now of the "Super 7" laminated design, based on the Vogt formula and abundant field experience.



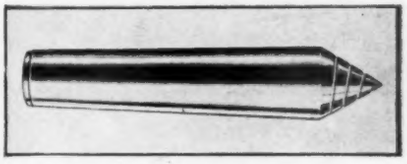
Acro Die Cradle Speeds Machining Operations on Dies

The Acro Die Cradle, recently announced by the Acro Tool & Die Works, 2815 Montrose Ave., Chicago, Ill., is adjustable in length and eliminates makeshift methods for supporting dies, jigs and metal parts while drilling, counterboring, tapping, milling, or grinding. The die cradle is easy to manipulate, since there are only two thumb screws for quick adjustment to any desired length. The standard height of the parallels is 7 in., and there is an adjustment for length up to 20 in. The universal parallel unit is made of high-grade steel, hardened and ground to close tolerances, thereby assuring accuracy. It is sturdy in construction, yet is light enough to be moved about with ease.



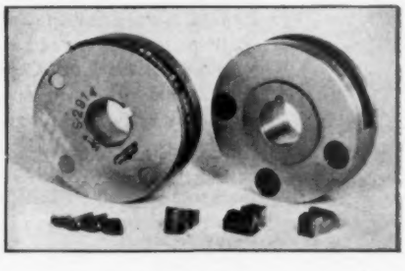
CMD Helical Groove Lathe Center Provides Better Lubrication

The new helical groove lathe center manufactured by Chicago Mfg. & Distributing Co., 1928 W. 46th St., Chicago, Ill., has left-handed helical grooves which lubricate the entire surface of work supported by the dead center on tailstock. The grooves hold a supply of lubricant for replenishing oil which dissipates on account of heat generated by the center after expansion caused by the heat generated by cutting tools. The left-hand helical grooves prevent lubricant from dripping, or from being forced out of the work. No stopping of the lathe is necessary to relubricate the center or the work. Similarly, no readjustment of tailstock is necessary. The center, when used with a good lubricating oil, can be used for either slow or high speed work.



New Method Rotary Marker Has Interchangeable Figures

New Method Steel Stamps, Inc., 143 Jos. Campau St., Detroit, Mich., is now manufacturing a rotary or roll-type marking device in which the letters or figures are interchangeable. It is de-



Step up P-Q* to RATED CAPACITY-PLUS

with SUNOCO EMULSIFYING CUTTING OIL

Rough turning 5" diameter shaft on a Monarch 20" model M engine lathe. Courtesy of Monarch Machine Tool Co.

With the order of "all-out production" from rough cut to finish grind . . . you need perfect coordination between operator . . . machine tool . . . and cutting lubricant to get the highest P-Q* throughout your plant.

And that's exactly why leading machine tool builders choose, use and recommend SUNOCO Emulsifying Cutting Oil to keep their machine tools operating at rated capacity-*plus*. SUNOCO's high lubricating and heat absorbing qualities protect tools from seizing, burning and chipping. . . . Make possible prolonged tool life . . . stepped-up operator's productive time . . . and machine tool performance at rated capacity-*plus*. SUNOCO helps maintain a higher P-Q* —Production Quota.

Give "priority" to production in your plant . . . let Sunoco help step-up the P-Q of your machine tools and put performance on a rated capacity-*plus* basis.

SUN OIL COMPANY · PHILADELPHIA

Sponsors of Sunoco News Voice of the Air — Lowell Thomas

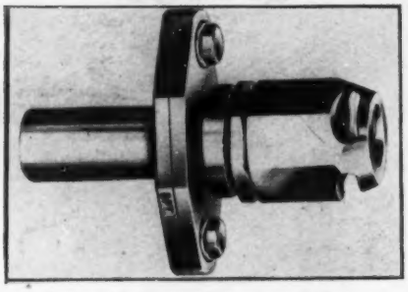
SUN OILS

PETROLEUM PRODUCTS FOR ALL INDUSTRIES

Copyright 1941 by Sun Oil Company

signed for rapidly and automatically marking cylindrical parts in production, including shell and other ordnance units. A special design feature of the device is that it securely retains in position all the individual type letters or figures even when marking the hard materials. Any slight movement of the type which might cause blurring or inaccurate marking is thereby eliminated. When type and spacers do not completely occupy the full opening, a movable locking device takes up the remaining open space.

Alco Acorn Type Die Holder Designed for Turret Lathes

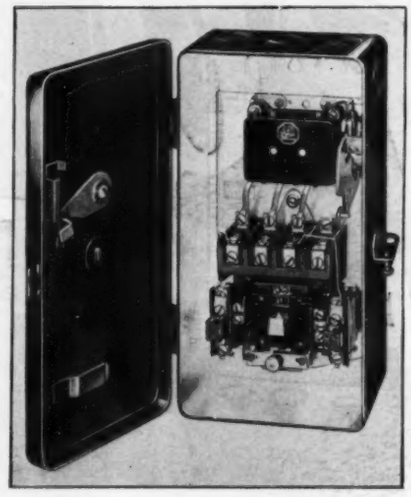


A releasing model acorn-type die holder for hand screw machines and turret lathes has been placed in production by the Alco Tool Co., 835 Housatonic Ave., Bridgeport, Conn. This new model has the same adjustable concentric alignment feature as the model formerly announced for the automatic screw machines. Since no pins are used, the drive is very rigid, and the die holder can be used on old machines with worn turrets and sloppy bearings to produce good work. A ground bearing surface in the nut contacts a similar ground surface on the body, assuring alignment of die regardless of thread fit. There are large openings for chip elimination and proper lubrication.

Allen-Bradley Redesigns Bulletin 712 Starters

The unique handle-locking arrangement and a compact, high-capacity disconnect switch are among several new features of a new line of Bulletin 712 combination starters developed by Allen-Bradley Co., 1311 S. First St., Milwaukee, Wis., to replace their former Bulletin 712 starters. By combining a magnetic switch with a hand disconnect switch in the same inclosure, these starters save wiring, insure greater safety to the operator, and result in compact installation of improved appearance.

The disconnect switch lever is located in the front instead of on the side of the cabinet. Three holes for padlocks in the disconnect switch lever permit the switch to be locked when the lever is "off." One, two, or three padlocks can be used. Hence, electrician, mechanic and millwright may each insert padlocks and the switch

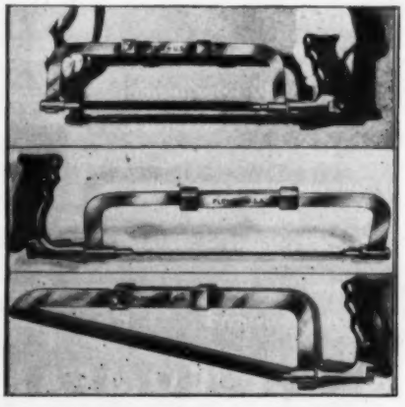


cannot be closed until all three padlocks are removed.

Available in four sizes and a variety of inclosures, with or without fuse switch. Ratings range from 2 hp., 220, 440, 550 volts for the Size 0 starter to 30 hp., 220 volts, and 50 hp., 440-550 volts for the Size 3 starter. All sizes have an interrupting capacity of at least ten times the maximum horsepower rating. Locked rotor currents are disrupted by either the solenoid switch or the disconnect switch.

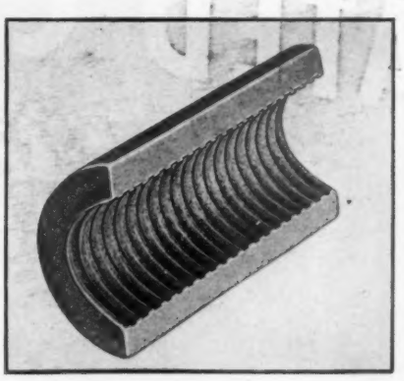
Plomb Firmback Hacksaw Can be Set at Any Angle

The frame of this new type of hacksaw, known as the Plomb Firmback, is so designed that it can be set at an angle with the pistol grip handle. The hacksaw, made by the Plomb Tool Co., Washington & Santa Fe Ave., Los Angeles, Calif., also has adjustable blade mounts that keep blades straight at all times, thus minimizing breakage. The pistol grip handle is so mounted on the frame as to give direct push and pull action on the blade. It can be turned to any position to get close-up cuts in spite of obstructions. The blade can also be turned and positively set at any angle, increasing the ability of this tool to reach ordinarily inaccessible places. The frame is also adjustable to take all popular lengths of blades, and the blade mounts are movable up or down on the legs of the frame.



Brightboy Rubber Tablet Finishes Curved Surfaces

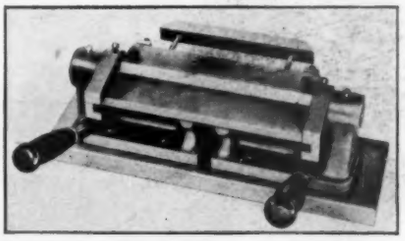
Designed to speed the finishing and polishing of curved metal surfaces, the Half Round Brightboy Tablet just developed by the Weldon Roberts Rubber Co., Sixth Ave. and No. 13th St., Newark, N. J., is made in the same compound as the other Brightboy products—a soft rubber binder which cushions the abrasive. It is semi-circular in cross section and both inner



and outer surfaces can be used. The inner surface is corrugated for faster action.

Almost as pliable as a rubber eraser, Brightboy Half Round Tablet can be compressed by hand to conform to the diameter of tubing or shafting; or it may be squeezed into the hollow of tubes, bushings or flanges. It finishes and polishes these surfaces quickly and effectively.

Micro Die Duplicating Brake Has 8-In. Folding Width



Designed for working material as used in aircraft, communication, electrical, and instrument manufacture, the new No. 2 Micro Die duplicating brake of O'Neil-Irwin Mfg. Co., 316 Eighth Ave., So., Minneapolis, Minn., has a maximum width capacity of 8 in. Using the handles at both ends simultaneously, the maximum folding capacity, full width, is 14-gage steel plate. Maximum folding capacity using only one handle with either right or left hand is 18-gage steel plate. Heavier gages of more ductile materials can be handled in proportion. Maximum angular folding radius is 110 deg. Precision adjustable stops provide for accurately duplicating angles, channels and vees to an accuracy of within 0.001 in. of duplicated work.

The brake is constructed of heavy

COLD DRAWN STEEL SHAPES

such as these hinge sections, have accurate cross sections—save machining.

J&L STEEL

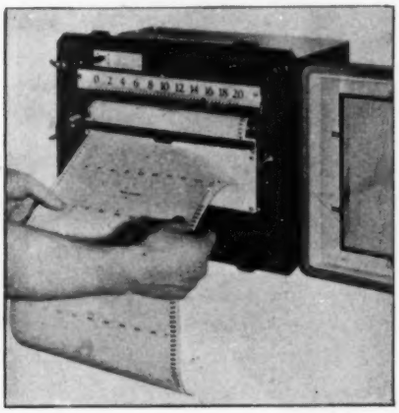
JONES & LAUGHLIN STEEL CORPORATION

AMERICAN IRON AND STEEL WORKS • PITTSBURGH, PENNSYLVANIA

machine-tool gray iron castings and cold rolled steel. Ample end bearings are of cold-rolled steel to gray cast iron. All contact parts are properly hardened and heat-treated. Main bearings are lubricated by oil cups.

Daily Strip Chart Feature Added to Celectray Recorder

Celectray recorders and recorder-controllers, made by C. J. Tagliabue Mfg. Co., Brooklyn, N. Y., are now available with a new tear-off feature. The added



mechanism consists of a tear-off bar and a re-roll with clip and tape. The clip, of a special design without springs, firmly grips the chart after a chart section has been removed.

It is claimed that this feature is particularly useful for daily records as well as a complete record of any batch or run. These short chart strips can be easily filed for ready reference. It also minimizes chart waste. When daily records are required a special chart can be furnished, with hour markings and with sufficient space to allow for resetting on correct time line.

Cold Worked Copper Can Be Hard Soldered by Tempobrazing

"Tempobrazing", a new process announced by the Thomson-Gibb Electric Welding Co., 164 Pleasant St., Lynn, Mass., eliminates the difficulty of brazing cold-worked non-ferrous materials without losing the hardness or temper that occurs in and around the joints. This loss of hardness is particularly noticeable in the case of ordinary brazed joints made in cold-worked copper and copper alloys. Ordinary brazing operations leave the metal fully annealed or "dead soft."

By employing accurately metered electrical energy and special solder having a flow temperature low enough to make excessive heating unnecessary, Tempobrazing makes possible the accurate dual control of both the amount and time of heat application. The operation is performed in a resistance seam welder with suitable means for inserting a silver brazing alloy, furnished by Handy and Harmon, of Bridgeport, Conn., between the pieces being brazed. Means are incorporated for chilling the work as rapidly as the joint is made. The brazing alloy is in the form of a thin ribbon as wide as the intended joint. When cooled and hardened, it forms a very thin homogenous film, free from irregularities, voids or orifices.

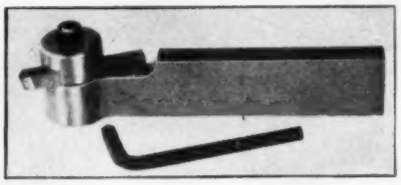
Tempobrazing cannot be applied under conditions where rapid heating and chilling is impossible or not practical and offers no advantage beyond high production if the metal is already in an annealed state, or if it must be reworked for some reason not associated with the brazing operation.

Wayne Lubricants Speed Drawing And Machining of Aluminum

Two new lubricants for aluminum and its alloys have been announced by Wayne Chemical Products Co., 9450 Fulton St., Detroit, Mich. The No. 4 Aluminum Drawing Oil is a viscous lubricant that does not "squeeze out" under the great pressures exerted in deep drawing thin sheets of aluminum. It has recently been adopted by several large press plants now working on Defense Orders, especially airplane body parts, large cooking vessels and the like.

No. 2 Aluminum Cutting Oil is a very thin oil that provides the necessary lubricating properties to insure good finish, perfect threads, clean holes, and similar marks of quality machining.

Flexoid Tool Holder Sets Tool at All Angles



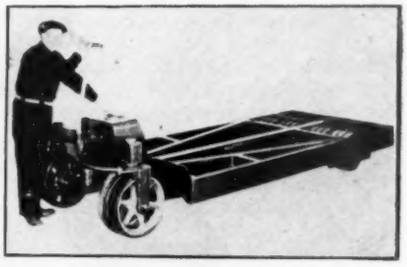
The universal head of the new Flexoid tool holder of the Smith Power Transmission Co., 1545 E. 23rd St., Cleveland, Ohio, eliminates the need of right, straight or left-hand shank toolholders. The design of the head permits setting the tool in all positions. No change in center is necessary when resetting the cutter. The tool holder is of hard alloy steel. Available with holder sizes ranging from ⅜ to ⅞ in., sizes of cutter square ranging from ¼ to ½ in., and overall length ranging from 6 to 10 in.

Small, Light Weight Air Hose Developed by U. S. Rubber

Weighing only 20 lb. per 100 ft., a new air hose which cuts in half the load to be carried by workers handling pneumatic tools has been announced by the United States Rubber Co., Rockefeller Center, New York, N. Y. Reduction in the weight of this hose likewise increases its flexibility, important for riveting and chipping in many tight quarters such as on board ship. Strength has not been sacrificed by lightening the new hose. It is made with a $\frac{1}{16}$-in. thick oil-resisting rubber tube, one ply of specially braided light-weight yarn, and a $\frac{1}{16}$-in. abrasion-resisting cover. Its burst value is approximately nine times the average operating pressure encountered. The new product is said to be in line with the recent tendency to lighten tools used in pneumatic work; a heavy hose tends to throw such tools out of balance. The durability of this hose is particularly necessary because of the common practice workers have—that of kinking the hose from four to eight times per day to shut off the air pressure while oiling the tools.

Lewis-Shepard Hand Lift Truck Handles Large Machine Tools

Extra large hydraulic hand-lift trucks in capacities up to 35,000 lb., have just been announced by the Lewis-Shepard Sales Corp., 245 Walnut St., Water-



town, Mass. The truck illustrated is of 35,000 lb. capacity, with a platform length of 10 ft. and a width of 5 ft. The lowered height of the platform is 15 in. This truck has four rear wheels, 15 in. in diameter with 10 in. face, mounted on heavy-duty roller bearings. Four front wheels, 20 in. in diameter with 5 in. face, are mounted in an auto-type steering assembly on heavy-duty roller bearings. Truck is arc-welded throughout and rigidly braced in every direction to prevent deflection and weaving. Rugged heavy-duty hydraulic lifting mechanism is inclosed to protect it against dust and dirt. Lowering of this truck is controlled by a variable speed dead-man type control lever to assure shockless lowering, and to prevent damage to the load. The load can be locked at any height.

Acromark Develops Fast Method For Marking Enameled Metals

A method for marking enameled metals, requiring the use of a specially engraved steel die, hardened and tempered, and resulting in a mark as permanent as the enamel, has been announced by the Acromark Corp., 251-257 N. Broad St., Elizabeth, N. J. The die may be an engraved roller or a

MAKING AMERICA SAFE

. . . *with* Precision Machine Tools

SUCCESS of the vast effort to attain national security is based directly on how swiftly manufacturers can produce . . . produce without any sacrifice of those standards of accuracy that have made mass production of interchangeable metal parts a distinct American accomplishment. *Ex-Cell-O's place in the great emergency is obvious.* As one of the nation's leading builders of machine tools, its high-precision products have for years contributed to the increasing of metal working efficiency . . . today, practically every branch of modern industry depends upon them when accuracy, speed, economy are the requirements. The same superior skill and experience that made these Ex-Cell-O achievements possible in the past . . . that have made Ex-Cell-O a common word for precision wherever machine tools are used . . . are willingly pledged to the great task now placed upon them—to serve American industry to the ultimate degree of human power in the supreme job of protecting America.

EX-CELL-O CORPORATION • DETROIT, MICHIGAN

XLO

Precision THREAD GRINDING, BORING AND LAPPING MACHINES, TOOL GRINDERS, HYDRAULIC POWER UNITS, GRINDING SPINDLES, BROACHES, CUTTING TOOLS, DRILL JIG BUSHINGS

flat one, and the material to be marked determines the area practical to mark. Where the metal varies greatly in thickness and is not uniform at any definite point, the mark must be limited to a small one; but if the metal is uniform in thickness, a mark up to 2x4 in. can be attractively applied.

By the roll method, an electrically heated roll passes over a metallic or pigment treated tape furnished in rolls in silver, gold, white, black, blue, yellow or other standard color. As the engraved design or lettering indents the enamel softened by the heat, the color is impressed into the enamel and into the metal. The flat steel die method is similar to the above, except that the sharp and deep die is sunk hot through the enamel into the metal. Using special dies, and the pigment- or metallic-coated tape, the same method can be applied to plastics. Experiments with alumilited materials and other finishes on aluminum, copper and brass have been successful.

Goodrich Tire Prevents Sparks By Conducting Static Charges

For use in manufacturing plants where static electricity constitutes a fire and explosion hazard, the B. F. Goodrich Co., Akron, Ohio, has developed a special rubber compound with a million times the electrical conductivity of tires made of ordinary rubber. Function of the new tires, available in a complete range of sizes for pressed-on and vulcon mountings, is to prevent the accumulation of any charge of static electricity large enough to produce a spark when the vehicle comes in contact with any other object. Where industrial trucks or tractors operate on floors of cement, brick, stone or metal, the new tires continually dissipate the static electricity.

The new product, called Conductor Industrial Tires, is expected to be of special value to plants engaged in the manufacture of armament, gun-powder, or other inflammable or explosive materials or products. One of the first applications was for tail wheel tires for aircraft, to bleed off static electricity built up during the airplane's flight.

Offset Marker Increases Range Of Brown & Sharpe Height Gage

Two new precision Offset Markers developed by The Brown & Sharpe Mfg. Co., Providence, R. I., increase the usefulness of Brown & Sharpe Vernier Height Gage No. 585. With them, measurements can be taken as low as the plane of the surface on which height gage is placed and also in shallow recesses. When used in inverted position they extend the range of the height gage with a straight marker, as illustrated. The marker arm is made unusually long, an advantage in measuring over projections. These markers

are available in two sizes: 3 in. long overall, for use with Brown & Sharpe 10-in. Vernier Height Gage, and 4 in. long over-all, for use with Brown & Sharpe 18-in. and 24-in. Vernier Height Gages. The markers are designated No. 585C and No. 585D.

NEW MATERIALS

Electro-Jetal Gives Rustproof Finish on Copper

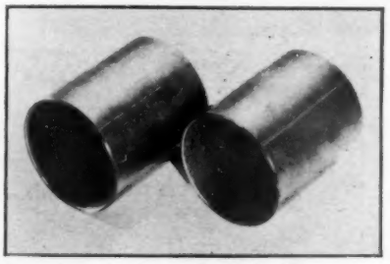
Any metal that can be copper-plated can be blackened and rustproofed by Electro-Jetalizing, a new process originated by the Alrose Chemical Co., Providence, R. I. After preplating with copper, products are immersed in a special electrolytic oxidizing bath for 2 to 5 min. The resulting velvety black surface is an excellent absorptive base for an after-treatment of oil, wax or lacquer, which gives a non-porous rustproof finish equivalent to ordinary nickel plate. The new Electro-Jetal bath can be operated at any temperature below the boiling point of water, using ordinary steel containers heated by steam coil. Work can be oxidized on racks, in bulk or baskets. The chemical cost, exclusive of the copper plate, is approximately 25 cents per 1,000 sq.ft. of surface.

Porex Porous Metal Filters And Diffuses Fluids and Gases

Porex, a porous metal whose chief functions are to break up into small streams or masses the main flow of fluids, to remove undesirable materials, to separate two fluids, to serve as a diffusing medium in bringing fluids and gases into intimate contact under controlled conditions, has been announced by Moraine Products Div., General Motors Corp., Dayton, Ohio. Porex can serve not only in filtering, but also in many other applications, typical among which are filters for fuel oils, lubricating oils, and solvents, and for removing oil from air, refrigerants, and water from gasoline. Present applications are limited to protective devices to remove harmful particles from fluids passing through small orifices. Available in disks, sheets, cylinders, truncated cones, and special shapes. Porex is not readily machinable.

Bronze-On-Steel Bearings Announced by Johnson

Pre-cast bearing Bronze-on-Steel, recently announced by Johnson Bronze Co., New Castle, Pa., has a higher brinell hardness, a greater resistance to pounding and to shock, and has a comparatively low coefficient of friction when compared with cast bronze bearings. The Bronze-on-Steel bearing is essentially a thin wall, laminated type of bearing that combines the bearing qualities of a high grade alloy with the strength of steel. The bronze alloy is first cast in solid bars so as to form a definite copper-tin eutectic, with the lead trapped in the interstices. The center of each casting is then drilled out, and the borings thus obtained are reduced to a powder, treated in a hydrogen furnace to remove all



oxides and then firmly bonded to strip steel. The process of manufacturing bearings from the strip Bronze-on-Steel is the same as for any other type of sheet metal bearing.

The Bronze-on-Steel in strip form is ideal for many applications requiring a flat bearing surface, such as plates, washers, and special bearing shapes. The bronze can be bonded to both surfaces of the steel if required. Graphited bearings are also available.

TRADE PUBLICATIONS

BALL BEARINGS New Departure, Div. General Motors Sales Corp., Bristol, Conn., is circulating a new shop manual which illustrates and describes ball bearing mounting and maintenance practice. The booklet is available to all factory managers in sufficient quantity to supply their interested personnel.

BEARINGS Johnson Bronze Co., New Castle, Pa., is circulating a new folder "Pre-Cast Bearing Bronze on Steel," which provides illustrations and specifications.

CENTRIFUGALS The Leon J. Barrett Co., Worcester, Mass., is circulat-

ing a four-page folder which illustrates, describes and provides specifications of sterilizers and other centrifugals.

COMPRESSORS Pennsylvania Pump & Compressor Co., Easton, Pa., is circulating Folder No. 193 which illustrates the operation and describes the characteristics of single and two-stage air compressors.

CONVEYORS Stephens - Adamson Mfg. Co., Aurora, Ill., is circulating Vol. 187, "The Labor Saver," which is a 20-page catalog illustrating and describing methods of saving labor while conveying materials.

CYLINDERS Hanna Engineering Works, 1765 Elston Ave., Chicago, Ill. is circulating catalog No. 230 which illustrates and describes the full line of Hanna cylinders, together with valuable engineering data, specifications and applications. Also included in this catalog is information covering control valves and hoists.

DIESEL ENGINES Caterpillar Tractor Co., Peoria, Ill. is circulating a 16-page booklet No. 6636, which contains statements made by users of Caterpillar diesel power.

FITTINGS AND TUBING Bulletin No. 3101 circulated by the Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago, Ill., contains 16-pages of illustrations and descriptions and specifications of Hi-Duty fittings and tubing.

LABOR TRAINING The American Management Association, 330 W. 42nd St., New York, N. Y., has recently published three booklets describing the recent trends in labor training and employment problems. Booklet No. 125, "Company Problems of Multiple-Shift Operation," sold for 50 cents, contains short articles on the Scovill Mfg. Co.; Armstrong Cork Co.; Kearney & Trecker Corp.; Merck & Co., Inc.; and Thompson Products, Inc. Booklet No. 127, "Selection and Development of Foreman and Workers," which sells for 75 cents, contains short articles on the Procter & Gamble Co.; General Electric Co.; the National Association of Foremen; Vega Airplane Co.; and Johnson and Johnson. Booklet No. 126, "Industrial Training Programs for Increased Production," which sells for 75 cents, contains short articles about General Motors Institute; the Warner & Swasey Co.; Bethlehem Steel Co.; Armstrong Cork Co.; and the United States Department of Labor.

MOTORS The Bodine Electric Co., 2250 W. Ohio St., Chicago, Ill., has published a four-page folder, Vol. 21, No. 3, which illustrates and describes small motors for quiet operation.

PROTECTORS The Boyer-Campbell Co., 6540 Antoine St., Detroit, Mich., is

(Advertisement)

Manufacturers Look to Steel Warehouses for Quick Defense Requirements

Many leading manufacturers are relying on nearby steel-service plants for prompt, stock shipment of steel to meet the current surge of business prompted by our National Defense Program.

Probably the leading exponent of "Immediate Steel" is Joseph T. Ryerson & Son, Inc., with their net work of ten strategically-located plants, each of which is completely equipped for prompt service on steel and allied products, formed and cut to customers' exact requirements. No shop should be without the Ryerson Stock List (see advertisement below).

Thousands of manufacturers report saving considerable time, trouble and money by taking advantage of Ryerson's complete flame cutting service. Modern equipment manned by specially trained operators can quickly burn any shape—no matter how intricate—from carbon or alloy steel plates and billets up to 15" thick.

It is fortunate
in this National Emergency
that there are

RESERVE STEEL STOCKS AVAILABLE

Ryerson has 10 steel-service plants strategically located in important industrial areas for quick stock shipment of rush orders. Without these available stocks, mill production would be seriously reduced by frequent changing of rolls to supply especially urgent requirements.

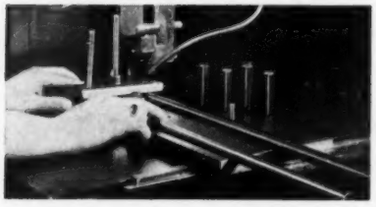
Stocks at the 10 Ryerson plants--America's great Reservoir of Steel--are quite complete, and service in general is prompt. In times like these, however, some sizes of certain products are naturally low, a few are out. But for the most part, you can depend on Ryerson for good service on reasonable quantities of over 10,000 different kinds, shapes and sizes of steel and allied products.

Joseph T. Ryerson & Son, Inc. Plants at: Chicago, Milwaukee, St. Louis, Cincinnati, Cleveland, Detroit, Buffalo, Philadelphia, Boston, Jersey City.

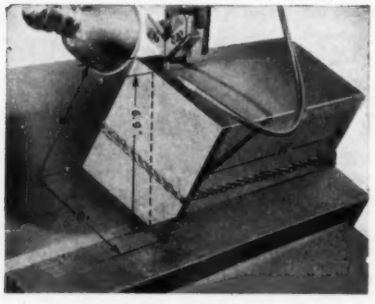
RYERSON *Certified* **STEELS**

DoAll SAWS

Aluminum, asbestos, Bakelite, brass, bronze, copper, cast iron, fiber, mica, Monel metal, nickel silver, porcelain, pipe, slate, zinc—DoAll Saws cut any kind of steel, alloy, plastic etc.

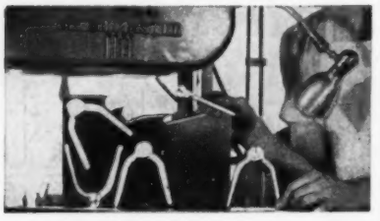


Pipe cut to accurate lengths with aid of simple attachment.



Steel block sawed in half on a 30° angle at the Swanson Tool & Machine Co., Erie, Pa.

30 minutes to saw off one side and cut notch in other side of hot rolled steel die parts. Speed, 150 f.p.m.



Type Bar Aligning Pliers cut from ⅜" cold rolled steel. 3 made in 1 hour with DoAll Saws. Former time, 16 hours.

Sheet metal is stacked and 40 or 50 shapes sawed at one time.

DoAll Band Saws come in compact metal boxes, for safe, easier handling and storing.

Send for booklet:

Actual Performance Records of DoAll Saws

FREE TEST

—Let our Saw Testing Laboratory experiment with any tough metal cutting job you have, and show you the most efficient and economical way to handle it.

THE DOALL COMPANY

1210 THACKER ST., DES PLAINES, ILL.

Associated with Continental Machines, Inc., Minneapolis,

DO ALL SAWS

circulating a four-page circular, "Protection for the Eyes and Face," which features 20 different models of face shields.

PUMPS The New Jersey Machine Corp., 965 Broad St., Newark, N. J., has just published a new catalog which provides schematic drawings and pump ratings for the Motoair vacuum and pressure pumps.

PUMPS Worthington Pump & Machinery Corp., Harrison, N. J., has published a six-page bulletin, No. W-412-B30, which illustrates and describes the operation and construction of duplex double-acting plunger pumps.

ROLL FEEDS The Wittek Mfg. Co., Chicago, is circulating Bulletin No. WF-339 which contains complete information on automatic roll feeds which provide an improved and simplified method of punch press operation assuring rapid feeding under all conditions.

SPOT WELDING TIMERS Westinghouse Electric & Mfg. Co. is circulating leaflet No. 18-335, which describes ignitron spot-welding timers employed to control the welding of aluminum, heat treated alloys, and other materials. Applications, distinct features, and construction are discussed.

TUBE STANDARDS A revised list of standard specifications, technical data card No. 107A, for seamless tubes and pipe is being circulated by the Babcock & Wilcox Tube Co., Beaver Falls, Pa. The booklet includes many illustrations and descriptions.

WELDED BASE PLATE Link-Belt Co., 2410 W. 18th St., Chicago, Ill., is circulating an eight-page booklet, No. 1882, which illustrates and describes the company's line of welded steel base plates for adjusting pillow blocks and common flat boxes for shaft alignment.

WELDING Metal & Thermit Corp., 120 Broadway, New York, N. Y., is circulating a 30-page booklet, No. 18 D, which illustrates and describes the application, operation, and result of Thermit welding.

WELDED JOINTS The Engineering Experiment Station, University of Illinois, Urbana, has reported on an investigation, "Fatigue Tests of Welded Joints in Structural Steel Plates." The investigation which was made in cooperation with the Public Roads Administration, the Chicago Bridge & Iron Co., and the Bureau of Ships, U. S. Navy, is told in 84 pages and sells for $1.

UPGRADING PRODUCTION WORKERS The Industrial Relations Section, Princeton University, Princeton, N. J., is circulating a new booklet, No. VIII, "Upgrading of Production Workers," which sells for 20 cents.

TO THE EDITOR

The Public Pays

Dear Sir:

The progress of arc welding is being held back much more by people who could know the facts and will not than by all the people who condemn it from ignorance. The criticism which has been directed toward arc welding has forced many would-be users to employ antiquated methods which are less reliable and more dangerous. The reasoning of the critics is that since no one can see into a welded joint, it should not be used. However, the same critics do not hesitate to use steel which, without question, is equally dense and much more variable in quality.

Because average men and, of course, average consumers, hesitate to adopt new ideas they are, by their conservatism, condemned to pay much more for an inferior article. Millions of dollars are being lost annually by consumers because of this conservatism.

It is time that we overcome this truly American trait in which we take so much pride. We should not allow this economic loss to continue merely because of our ideas of conservatism. After all, these conservatives do not pay the bill. That is paid by the consumer who wants progress and safety. He is tired of paying for Tacoma bridges which, if designed for welding, would have cost less and would still be standing.

Yours very truly,
J. F. Lincoln, President,
Lincoln Electric Company.

Turn About

Dear Sir:

With real alarm I call your attention to the lack of sufficient skilled surgeons to serve in the "emergency" repairing and keeping fit of the man power for our defense. Copying somewhat from the preparations being made to turn out skilled machinists by a few weeks of training under the auspices of the National Youth Administration in connection with the national defense program, I offer the following suggestions:

1. Petition the Chief Executive and secure the appointment of Daniel J. Tobin, an experienced teamster, to supervise the training of surgeons from the young men who Sidney Hillman, the experienced ladies' garment worker, does not think have the qualifications to become machinists in a short time, if any.

2. Secure the cooperation of the owners of the country's many slaughterhouses and packing-houses to provide some opportunity for the boys to get a little first-hand knowledge of meat cutting and bone sawing. A couple of

War machines and munitions have to be good to stand up under war conditions. They must be made rapidly in huge quantities by a variety of plants. All parts must be strictly interchangeable.

Hence the task of guarding quality becomes a matter of life and death importance to a nation rearming to preserve its liberty.

Sheffield Visual Gages are stalwart guardians of dimensional quality. They are used in checking dimensions of manufactured and purchased parts, tools, production and master gages.

The sturdy Reed Mechanism, combined with the light beam lever arm, provides a sensitivity to meet the highest precision standards of measurement—but without the delicate fragility so often associated with sensitivity.

These gages are not delicate, they are strong and deadly accurate. They are made in various models to check accurately to thousandths, "tenths" or millionths of an inch and all provide rapid, easy gaging to any limits required on production work.

Write for information.

THE SHEFFIELD CORPORATION
Gage Division · DAYTON, OHIO, U.S.A.

SHEFFIELD MASTER GAGEMAKERS

The FIRST CUTTING COMPOUND Developed Especially for CARBIDE and other VERY HIGH SPEED CUTTING TOOLS

Stuart's SOLVOL AQUAMIX Liquid Cutting Compound

Try It Quickly and See The Difference

THE rapidly increasing use of carbide and other high speed tools emphasizes the immediate importance of this original type of cutting fluid. STUART'S SOLVOL Liquid Cutting Compound was developed especially for this exact condition. Where operations run "too hot" for properly applied straight cutting oils — and where ordinary soluble cutting oils or soluble paste compounds fail to produce satisfactory finish or tool life—that's the place for this original Stuart Oil development.

•

WIRE TODAY for working sample—FREE to any industrial concern working on defense orders. To assure proper application please tell us name of part, stock, machine and cutting operations.

For All Cutting Fluid Problems

D. A. STUART OIL CO. LIMITED

Chicago, U.S.A. Est. 1865

Warehouses in All Principal Metal Working Centers

weeks of this will be enough for any bright boy.

3. Purchase half a million each of 12-in. meat saws, manicure scissors, skinning knives, cleavers, meat hooks and like instruments, and distribute them among the various schools which qualify for this training course instruction.

4. Have the government printing office print half a million diplomas and ship them with the sets of instruments to the various schools so no time will be lost in certifying surgeons as fast as they are turned loose.

5. Pass a federal law abolishing the right of states to require doctors to pass state board examinations, and outlawing state boards of medical examiners.

6. Put the American College of Surgeons under the Interstate Commerce Commission and require it to issue a membership certificate to each holder of a Tobin diploma.

7. If the rat killing has not started by the time the boys frame their diplomas, put them on half pay as army surgeons and give some foreign country a little more time to throw a rock back at us.

I have not the slightest idea that you will do anything with this. . . .

Yours very truly,
LUCIEN I. YEOMANS
Lucien I. Yeomans, Inc.

Prizes for Welding

To the Editor

I have noted the announcement of the Summerill Tubing Company, of the establishment of a series of prizes for papers to advance the art of welding of aircraft steels, including tubing and other parts for assemblies.

Papers submitted in this contest will also be eligible in the $200,000 Industrial Progress Award Program which is being sponsored by the James F. Lincoln Arc Welding Foundation. Of course, such papers must comply with the Foundation's rules and conditions as regards subject matter and form.

Very truly yours,
ED. C. POWERS,
Assistant Secretary
The James F. Lincoln Arc Welding Foundation

Machine Tool Priorities

By FRED H. COLVIN

Having been both an active participant in and an observer of war preparations in 1917, I would like to point out some of the mistakes of that time. One of the difficulties was the allocation of machine tools to places where they were most needed. This same problem is here at present, and is one of the spots where real authority is needed. Then George Merryweather, assisted by Messrs. Einig and Baker (now head of machine tool procurement for the British) did a splendid job, after the need for such authority was recognized.

That similar authority is now necessary is shown by the avowed intention of at least one naval officer recently to get all he could, while the getting was good. This refers to the ruling that machine tools, and presumably other equipment, must be ordered when or before the keel is laid. I have been told of recent cases where lathes, needed immediately in industry, have been shipped and stored while awaiting the completion of ships two years hence.

This recalls a case in 1918 where a large and expensive machine with priority rating, was found after the war, still in its crate and so badly rusted as to be almost useless. Someone slipped a cog in ordering its shipment, it had not been followed up and its use had been lost to the suppliers of munitions.

No one should expect perfection. We all make mistakes in judgment and in the execution of orders. But these mistakes are more important in time of war when lives of both civilians and armed forces are at stake. We should be able to avoid some of these errors.

More Men for British Production

By JOHN S. TREVOR

As long ago as 1919 Britain's Ministry of Labor requisitioned a number of derelict armament factories from the Ministry of Munitions to train disabled ex-servicemen. The plan proved so successful that the government decided to enlarge its scope.

The original aim of the Ministry of Labor was not to turn out skilled craftsmen, but rather men with a working knowledge of a particular industry who could be absorbed into the various trades as handymen. This aim has undergone a gradual change until today it is to turn the unemployed into more than mere handymen—into improvers who, after some experience in a large shop, can qualify as skilled men able to earn full pay.

In spite of union opposition, employer indifference and employee inertia, this training center system has steadily developed until today there are fifteen centers throughout Britain which can accommodate some 10,000 men.

Since the outbreak of the war, metalworking has been chosen as the main industry for which to qualify men. Draftsmen are being trained, and trades open to selection by the men include milling, grinding, turning, toolmaking, instrument making, machine tool reconditioning, airplane engine assembly, sheet metal work and inspection. Courses require about 26 weeks; draftsmanship takes nine months. When he has duly qualified he is absorbed into industry through the usual channels of the unemployment exchange.

Arc Welding Aluminum

On page 630 of the recent section on the Working of Aluminum Alloys (*AM*—Vol. 84, page 617) appeared the statement "both d.c. and a.c. arc welding machines are suitable." Everett M. LeBel of Nashua, N. H., has called to our attention the fact that this statement is not in line with current practice in the metallic arc welding of aluminum alloys.

A statement to the effect that an a.c. welding machine to be used in the metallic arc welding of aluminum alloys must be equipped with a superimposed high-frequency current on the welding circuit to stabilize the arc, should have been used to qualify the original statement. At one time equipment of this type was available. Since its production has been discontinued, there is today practically no metallic arc welding done with a.c. equipment. Therefore, the initial statement on page 630 should have read "At the present time, only d.c. arc welding machines are suitable."

Machine Constant in Gear Design

By ED WEST

No matter how carefully they may be calculated and no matter how carefully the machine set-up is made, helical and herringbone gears prior to shaving will have errors in lead. Each machine for cutting gears will have its own slight error depending on its individual make-up, its age and other factors. Therefore, when it has been determined, for example, that there is an error in the lead of so many tenths per inch, this error should be included in all future gear calculations as a constant for the machine. Thus, the error which each machine always gives will be compensated for in the preliminary calculations and will not have to be corrected by later reworking the gear in the shop.

Deep Hole Drilling

By FRANK C. HUDSON

Deep hole boring has always been considered a special job. Special gun boring lathes are made by only a few lathe builders, and they cost a lot of money. But deep hole drilling is an every day job with machinists in the oil fields. They think nothing of boring, or drilling, a 3-in. hole through a shaft 50 ft. long. And they do it in a hurry and in inexpensive machines.

A husky driving head to revolve the shaft at a reasonable speed, a support for the shaft, frequently an endless link belt chain, and a way of feeding the drill into the shaft, makes up the machine. They get remarkably straight holes at 41 in. an hour for a 3-in. hole. Of course there is an oil flow into the hole, through the drill shank. On the 3-in. hole one shop uses 30 lb. of oil pressure.

Accuracy is an important qualification in a precision tool—no doubt the most important. But today a machinst deserves a lot more, and he gets it in a Lufkin. In every Lufkin tool you'll find little details that permit you to work faster, with more ease and less chance of error. It's these details and the effect they have on your work that mark the superior quality in tools by Lufkin. Our catalog illustrates and thoroughly describes each of them. Write for your copy.

BUY THROUGH YOUR DISTRIBUTOR

NEW YORK
106 Lafayette St

THE LUFKIN RULE CO
SAGINAW, MICHIGAN

Canadian Factory
WINDSOR, ONT.

TAPES — RULES — PRECISION TOOLS

A page for your Note Book

METAL SPINNING ROLL

Probably the best test for determining the resistance to wear of any tool steel is to place it in service as a metal spinning roll.

Such rolls should be free from surface fatigue which results in spalling or checking. The structure of the Graphitic Steels is ideal for this application.

There is no tendency to seize the metal being formed and the resultant product is satisfactory in every respect. Graph-Sil, heat treated as explained below, gives remarkable performance, using a working hardness of 64/65 Rockwell C.

When A = 4 ″, B = 1 ″, C = ¾″ } Quench in brine from 1450°F. Temper at 250°F. for four hours.

When A = 8 ″, B = 2 ″, C = 1½″ } Quench in brine from 1475°F. Temper at 250°F. for six hours.

MULTIPLE BLANKING DIE

This die must withstand the impact of at least twenty punches, applied at one time to produce perforations uniform in shape and location in blanked strip circles ranging in thickness from 1/8″ to 7/16″.

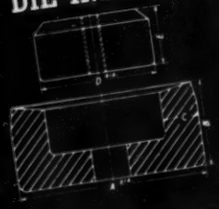
Here is a decidedly non-uniform section that presents a problem in hardening. It must have practically no change of dimension, no warpage after heat treatment and the blanking edges must be wear resistant and free from spalling.

We recommend Graph-Mo with a working hardness of 55 Rockwell C. obtained as follows:

When A = 8 ″, B = 1 ″, C = ¼″ } Heat to 1500°F. Quench in oil. Temper at 700°F. for four hours.

When A = 16 ″, B = 1½″, C = ½″ } Heat to 1550°F. Quench in oil. Temper at 700°F. for eight hours.

COINING PUNCH AND DIE INSERT



Coining of metal is generally admitted to be one of the most drastic operations to which dies, tools and equipment are subjected.

Due to high stresses set up in the die assembly, it is necessary in order to get a satisfactory number of coined parts that the steel used for this assembly be highly resistant to failure by fatigue. It must be capable of being hardened to a sufficient depth to withstand the high pressures without sinking, and must be free from any tendency to spall or fracture.

The recommended working hardness for Graph-Tung is 63/64 Rockwell C. obtained as follows:

When A = 4 ″, B = 2¼″, C = ¾″, D = 2½″, E = 1 ″ } Quench in brine from 1450°F. Temper at 400°F. for four hours.

When A = 6 ″, B = 4 ″, C = 1 ″, D = 4 ″, E = 1¼″ } Quench in brine from 1475°F. Temper at 400°F. for six hours.

Graphitic Steels are unsurpassed for their resistance to abrasion or wear. Further information available upon request.

TIMKEN
ALLOY STEELS

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO
Steel and Tube Division

Manufacturers of TIMKEN Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; TIMKEN Alloy Steels and Carbon and Alloy-Seamless Tubing; and TIMKEN Rock Bits.